WITH METALLURGICAL SECTION

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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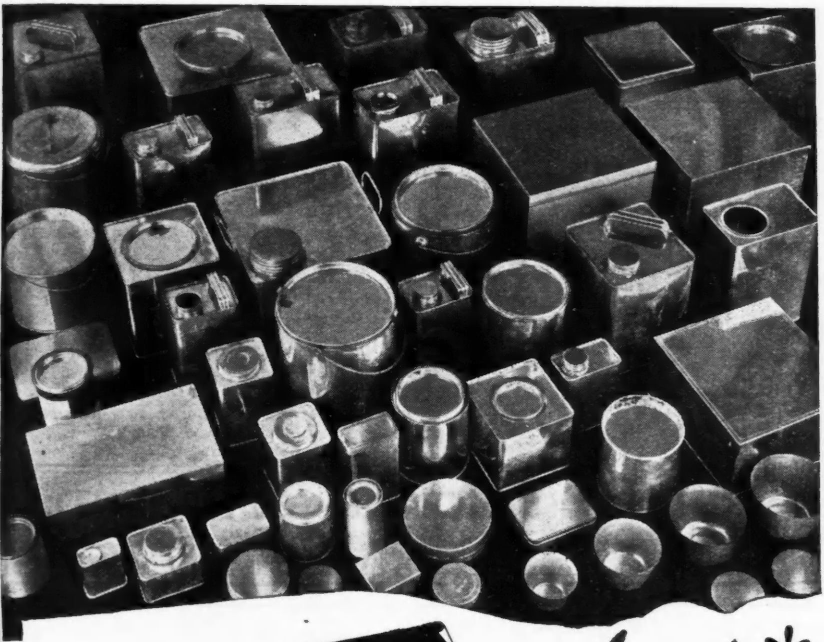

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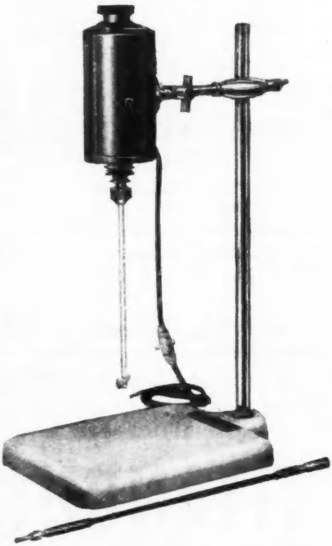

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The Chemical Age

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Industrial Policy

BRITISH industrial policy, as we have pointed out on more than one occasion recently, has changed profoundly within the lifetime of the older men. Those who were in industry before 1914 can recollect the passing of the bad old order of the industrial revolution and the coming of a new order. The young men who were in industry before 1939 have experienced a change equally striking. It is perhaps a little early to be sure whether this change will be permanent or not. Nevertheless, change it is and industrialists must meet the new conditions. During the whole period between the two German wars, and even before that time, there was a surplus of man-power. The result was unemployment, often on a very large scale. A great part of this country's income was derived from foreign investment; consequently, whether we produced goods at home or not did not matter greatly from the point of view of our standard of living. We could buy from abroad what we could not produce at home. We could afford to neglect foreign markets—and we certainly did so. The change that has come upon us is connected with the change in our financial position. No longer have we any considerable investment abroad, and therefore we have little income from abroad.

On Other Pages

In order to maintain our pre-war standard of imports, we must export goods in volume at least 75 per cent greater than we did in pre-1939 years. That means that we must produce more per head of the population in order to do so. We require goods for our own use also; since we cannot afford to be lavish in our foreign purchases we must produce a greater proportion of the goods we use at home. One example may be given: before the 1939 war we imported 40,000 tons of dried lucerne for cattle feeding; to-day we are manufacturing equivalent cattle food from dried grass at a cost just half that which we paid for the imported product. We believe that that is typical of many industries.

On June 30, 1939, we had a total labour force of 19,750,000; on June 30, 1946, our force was 20,228,000. The future labour force is likely to be reduced slightly, rather than to increase. Military service and other causes are increasing the average age of those in employment. The immediate need is to increase productivity per man. Labour is demanding shorter working hours, with more pay. It is a natural demand, and from purely psychological aspects, it is a good movement; but it further reduces the available man-hours

that can be worked, though probably increasing the efficiency of the worker. There will thus be sharp limits to the number of workers that are available, and those numbers will become less by reason of the passing of time, the ageing of the population and the increased desire for leisure. War has expanded the chemical and engineering industries, and this fact has led to still further reductions in available manpower in many other industries. The need is thus not only for increased production per man, but also and especially per man-hour.

The solution to this problem may be found in better management. In any case the situation is a challenge not only to management but also to technical skill. It is common to declare that production per man-shift is declining, but this is only part of the story. There are many factories where it is increasing. Mr. Victor Collins, M.P., stated recently that in a factory in South Wales, by putting production on a 7-hour, 5-day week basis (35 hours a week), sufficient economies have been made to enable the weekly earnings of the labour force to equal those of a similar factory on a 47-hour week and the cost of the article to be reduced slightly. The difference in apparent wage cost through working shorter hours was more than compensated by improved efficiency in method and lay-out, and consequent improvement in the efficiency of the workers. Another example may be given in Mr. Collins's own words: "In one of my factories we have in eight months increased production more than 100 per cent with only 25 per cent increase in the labour force and a reduction from a 47 to a 44-hour working week. In this case the workers' earnings have increased, but the vital wage cost per article has lessened considerably."

Nor is this all. Increased efficiency leading to decreased working hours is not the only factor. There must be an incentive to the workers to give of their best. Not all workers regard shorter working hours as their ambition in life. There are those to whom increased earnings appeal still more; when the income tax rates are reduced to a reasonable figure that incentive will become still more important. There should be no upper limit on earning power. In the bad old days the management frowned on high earnings. If piece-rates gave weekly earnings that appeared to be much greater than the day-work wage, the management concluded that they had made a bad bargain and promptly reduced piece-work rates. That is the wrong attitude, as the U.S.A. has shown us. Let men earn as much as they can, provided the cost per article falls rather than rises. The greatest need to-day is for a fair distribution of the results of increased efficiency between all engaged in business or manufacturing industry, and this will be brought about best by complete co-operation between all concerned. In that way there lies the opportunity to increase production and decrease costs. The scientist and the engineer are key men in the new order which has now arisen. Let us see that they play their part—and receive their due share in what is achieved.

NOTES AND COMMENTS

The New White Slave Traffic

MUCH space has been given in the daily Press to reports of the removal of thousands of technicians and skilled workmen to Russia from Germany. In addition to these wholesale removals of Germans with their families, inventories are being taken of some of the factories, with a view to their dismantling and re-erection in Russia.. In the case of the skilled workmen at the famous Karl Zeiss factory at Jena, *The Times* correspondent says that no warning was given of the impending removals, which the Germans did not hesitate to describe as deportations. Lorries drove up at 4 o'clock one morning to the houses of the men selected for removal to Russia. The houses were surrounded by soldiers and sentries posted in the streets. A Russian officer with soldiers and an interpreter entered each house, and told the men they had three hours to get ready to leave for Russia. People who have seen the removals say that few of the German workers left willingly. Among those removed were two professors of Jena University. Russian controlled newspapers in Berlin intimated that a few German specialists have left for Russia "gladly and voluntarily," but they hint that the Russians are only doing, on a small scale,

what the Americans and British, they say, have already done wholesale.

Brockenhurst Explosion

NEWSPAPER reports of the recent fatal explosion at Brockenhurst railway station have in most instances failed to make clear that it was not the gas cylinders themselves which exploded, but that the cause was a leakage of gas not attributable to any defect of the apparatus as such. This is an important point which those concerned with the development of this form of heating would do well to impress upon the general public, who otherwise may become unduly apprehensive. At the inquest the Coroner recorded that the explosion was caused by gas from the cellar rising owing to a draught and forming with air an explosive mixture which came into contact with a gas-ring. He found there had been " slackness " in the changing of the cylinders, while evidence indicated that although the leakage had been reported, the gas had not been cleared. There has been no suggestion whatever that this case implies any inherent danger in the gas cylinder apparatus.

Safety Precautions

THE fact that the gas is an inflammable commodity should be patent to any consumer with common sense, but reputable distributors of the apparatus spare no pains to bring the possible danger to the notice of consumers. A representative of one of the leading firms told us of how they stress the " safety first " angle, not only to their own staff but to consumers through the dealers. Cards, headed "How to disconnect and connect ——— Gas Cylinders," giving detailed instructions with diagrams and including in bold red type in more than one place warnings as to the inflammability of the gas and the precautions essential, are supplied with every regulator, and dealers are instructed to affix them to every installation. It is the general practice, furthermore, for cylinders to be fitted and serviced by trained personnel, if consumers take advantage of facilities normally provided by distributors. In all the circumstances, therefore, it would seem that the present tragedy did not arise from a mechanical defect. It was apparently the inevitable human element at fault again.

U.S. Titanium Deposit

REPORTS from Arkansas are quoted by the *Daily Telegraph* as authority for the belief that " an apparently inexhaustible deposit of titanium discovered in that State more than two years ago will make the United States independent of other nations in the development of atomic energy." This statement obviously requires clarification. Titanium occurs plentifully in several mineral forms and is used in metallurgy, chiefly alloyed with other metals, for a number of purposes. Ferro-titanium alloys, for instance, are used as deoxidising agents and as oxygen and nitrogen scavengers, a small quantity of titanium being of advantage for the final purification of nearly all grades of steel. Titanium oxide is well-known, of course, as an excellent paint pigment. The precise relationship between the uses we have instanced and the development of atomic energy is somewhat difficult to understand, particularly when it is remembered that the atomic weight of titanium is 47.90.

Cupro-Nickel

INEVITABLY a good deal of intemperate criticism has been hurled at the scheme for replacing the silver coin of the realm by cupro-nickel pieces. Oddly enough, however, the heaviest barrage has come, not from the traditionalists who hate to see the silver disappear, but from the proponents of a coinage of pure nickel. The allegation is that the new currency will be, as Lord Balfour of Inchrye put it, " drab, dreary, utility coinage," and that the decision to use cupro-nickel would have a bad effect on the Empire. A more technical estimation of the position has been put forward by a working metallurgist, Mr. W. F. Brazener, managing director of The Mint, Birmingham, Ltd. (which is in no way controlled by the Royal Mint). He points out, in a letter to *The Times*, that the usual cupro-nickel coinage alloy consists of 75 per cent copper and 25 per cent nickel, and that coins properly manufactured from this alloy are neither drab nor dull, nor are they yellowish in appearance. They are not soft, they do not corrode easily, and they are as difficult to counterfeit as a pure nickel coin. The m.p. of 75/25 cupro-nickel is 1210°C., about 150° higher than that of the present quaternary silver alloy. Hardness of finished coins is 128 Vickers (D.P.) as against 132 for nickel, a trivial difference from the point

of view of durability. A 70/30 cupro-nickel to alloy was used extensively for Admiralty condenser systems because of its resistance to corrosion, and the same could be said of the 80/20 bullet-envelope alloy. Among the valid objections to the proposed new coinage is the argument that the use of only 25 per cent nickel will not go so far to take the place of the war-time demand for Canadian nickel as would the employment of a pure nickel coinage, while it is also suggested that objections may be raised in such places as the Sudan, where British silver coins are in circulation.

A Proud War Record

THE organisation controlled by Thos. W. Ward, Ltd., from their headquarters at Albion Works, Sheffield, is nationwide, and the associate and subsidiary companies cover a multitude of occupations connected with the metallurgical and chemical industries. It is not to be wondered at, therefore, that they were called on to play an exciting and diversified part in the country's war work. Some account of this has now been published in the form of an attractively produced and well illustrated volume, entitled "End of a Chapter." Wisely, it does not set out to be a record of spectacular achievements, but is simply a day-to-day description of what had to be done and what was done—conditions which, to the credit of the companies concerned, approximated very closely to one another. The fact that this close approximation was the rule among our industrial firms during the war had an enormous amount to do, it will be admitted, with our ultimate success. Despite a wise insistence on the importance of the regular work, one or two "high spots" come in for a fair share of description. Such were the salving of the secrets of the *Graf Spee*, the construction of the underground aircraft factories, the repair of the Silvertown works after the visit of the Dorniers in September, 1940. Notable also are the illustrations of women at work on jobs which no one had thought them capable of doing, and of the tipping of a ladle of molten metal in Widnes Foundry.

A Sidelight on Ammonia

A GREAT many people have affectionate recollections of the work of Beatrix Potter, and *Peter Rabbit* and his junior colleagues have acquired well-established niches in the Hall of Literary Fame. Glancing the other day, however, through the recently-published Life* of this well-loved authoress, we were somewhat startled to come across a coloured representation of a Bunsen burner in full blast, attended by a learned and bespectacled Mouse engrossed in a chemical textbook; while a host of other mice are occupied in the background with a confused mass of test-tubes, rubber tubing, chemical balances, mortars, etc. We were somewhat relieved to find that our feeling of surprise had been shared by no less an authority than the late Sir Henry Roscoe, uncle of the artist, who had received the drawing as a gift from his accomplished niece. It should be explained that the drawing is entitled "A Dream of Toasted Cheese," and is in illustration of a statement, under the heading NH_3, in one of Sir Henry's own textbooks, to the effect that "the peculiar pungent smell of this compound is noticed if we heat a bit of CHEESE in a test-tube." We must confess that Miss Potter's vivid art has succeeded in portraying a mouse-professor who certainly looks as though he knew at least as much chemistry as many human professors whom we have encountered.

Aluminium Scrap

German Refined Method

A GERMAN filtration method for refining aluminium airplane scrap is described by American and British investigators as unique in metallurgy. The process is followed by a vacuum distillation, which produces aluminium suitable for re-use in all but the most critical aircraft parts.

The filtration method was used by I.G. Farben at Bitterfeld. The addition of an excess of molten magnesium to crudely refined melted scrap aluminium alloy was found to result in the formation of insoluble inter-metallic compounds of aluminium and magnesium with iron, manganese, silicon, chromium, vanadium, molybdenum, titanium, zirconium and cerium. These compounds could be filtered out as crystals when the mixture was cooled to near the point of solidification. The remaining mixture was heated in an atmosphere of hydrogen at a pressure of 2 mm of mercury in a closed furnace. By this means, all the remaining metals, except copper and small amounts of nickel and tin, were distilled out.

* THE TALE OF BEATRICE POTTER. By Margaret Lane (Frederick Warne; 12s. 6d.)

"The Inhibition of Corrosion"*

Measures for Indirect Fuel Saving

by W. F. GERRARD, A.R.I.C., M.Inst.F.

THE connection between corrosion of metals and fuel wastage may not be so obvious as that which exists, for example, between heat losses and boiler scale, but it is a very real one nevertheless. In fact, when the enormous quantity of fuel consumed in the manufacture of new equipment needed to replace that rendered prematurely useless by the ravages of corrosion is considered, the more subtle enemy may well prove to be the more formidable.

Evans[1] defines corrosion as "destruction by chemical or electro-chemical agencies" in contrast to erosion, which means "destruction by mechanical agencies." He quotes the rusting of iron as an instance of corrosion and the filing of iron as an example of erosion. Several writers have drawn attention to the identity existing between the products of corrosion and natural ores, and Watts[2] has aptly described corrosion as "a major industry in reverse—all loss and with never a profit." The elemental state is abhorrent to most metals, and iron, the most important of them all, will miss no opportunity to revert to the oxide or sulphide.

Corrosion Mechanisms

A clear appreciation of the fundamental corrosion processes is essential to the correct interpretation of a given case and greatly improves the chances of finding a satisfactory answer to the problems at issue. Even in dry air, freshly polished specimens of iron and steel quickly develop a surface film of oxide which slows down or "stifles" the conversion to oxide, though Vernon[3] has demonstrated that specimens continue to gain in weight owing to oxidation after months of exposure. Following a lead given by Vernon,[4] Murray[5] polished a number of specimens cut from the same piece of mild steel. Some of these were exposed directly to the laboratory atmosphere, while others were surrounded by a muslin cage. The method of suspension and other conditions were the same for all specimens.

Those in the "direct exposure" group rusted rapidly, but those protected from soot and dust particles remained bright for the duration of the experiment (three months). The muslin cage was then removed, but only slight tarnishing occurred during a further three months' exposure. The superior resistance of the protected specimens was attributed to the formation of a uniform oxide film over the surfaces. Finally, both sets of specimens were immersed in Liverpool town's water with deliberate aeration. Rusting continued apace on all specimens of the "direct exposure" group, but those which had been "cured" by protection in muslin were only attacked at the points of support where the oxide film was weak or ruptured.

A second experiment on the same plan employing improved suspension technique is in progress and it is already evident that a uniform film of oxide confers a high degree of protection against rusting, both in air and in water. Putting this conclusion in a more general way: the rate at which iron is corroded in air and in water is proportional to the rate at which oxygen reaches the surface of the metal.

Action of Acids

With this in mind, the action of acids is capable of a simple explanation. Iron oxide reacts with dilute hydrochloric, sulphuric, and hydrofluoric acids with production of the chloride, sulphate and fluoride of iron, all of which are soluble in water. Thus a fresh metallic surface is successively exposed, oxidised and dissolved, and so the cycle proceeds until the acid is exhausted or the specimen disappears. Lead resists sulphuric acid, siliver resists hydrochloric acid and magnesium, normally one of the most reactive of metals, withstands the action of hydrofluoric acid because lead sulphate, silver chloride, and magnesium fluoride are insoluble and take the place of oxide as protective films.[6]

Acids such as HCl and H_2SO_4 are present in small amounts in the atmosphere of industrial areas and in water supplies contaminated by waste liquors, but there is another impurity which, though its acid properties are less strongly marked, far outstrips them in importance because of its universal distribution in air and water. Carbon dioxide is produced by the respiraton of all animals, by decay of organic matter, and by combustion of any substance containing carbon. It is miscible in all proportions with air and so is ubiquitous in the atmosphere. If a sample of air were collected over the North Pole it would still be found to contain an appreciable amount of CO_2. Pure water has a neutral reaction, but when a trace of CO_2 is dissolved the water takes on a distinctly acid character. CO_2 is often called carbonic acid gas owing to the supposed formation of carbonic acid.

$$H_2O + CO_2 \rightarrow H_2CO_3.$$

* A paper read to the Conference on "Fuel and the Future" at the Central Hall, Westminster, on October 9.

Whether H_2CO_3 really exists as true chemical compound is of little moment, but the acidic reaction of CO_2 in water is a matter of the utmost significance. By its agency the film of oxide, which we have seen to be the main defence against corrosion of iron and steel, is converted into the relatively soluble carbonate which in turn decomposes into iron hydroxide and CO_2. The joint action of these two gases, oxygen and CO_2, is the commonest cause of general surface wastage, especially on iron and steel in contact with flowing water, which carries away the corrosion product (iron hydroxide) and is coloured red or reddish-brown in consequence. Sometimes the "red water" trouble is a greater nuisance than the corrosion problem itself. When the oxide film is constantly worn away by the scoring action of air, water or mechanical friction, so that the metal surface is continually exposed along a limited track, the result is popularly called "grooving."

Electro-Chemical Attack

Surface wastage, then, is a purely chemical process, but there is another and more dangerous form of attack due to electro-chemical causes and characterised by pitting. Differences in electrical potential on metallic surfaces can arise from a variety of causes, for example, if two dissimilar metals such as iron and copper are in close proximity, the salts dissolved in water may behave as conductors in an electric cell with copper as the cathode and iron as the anode. Reactions at the electrode surfaces will then result in solution of the iron and formation of alkali at the copper with precipitation of iron hydroxide at some intermediate place. Again, many metals, including iron, are anodic towards their own oxides and attack will be possible where the oxide film is weakened or broken.

A third type of electro-chemical corrosion occurs when the distribution of oxygen is unequal over a metal surface, the parts in contact with oxygen behaving as cathodes towards the unaerated parts. Activity of this kind is said to be due to differential aeration and is obviously liable to take place at or near water-line where the supply of oxygen is constantly replenished from the atmosphere, or at points in an installation where bubbles of oxygen can lurk, as at bends in pipe-lines. The theory of differential aeration accounts for the fierce corrosion which often goes on underneath a layer of scale, sludge, or paint when the metal nearby is exposed.

Underground installations in particular are subject to yet another type of electro-chemical corrosion by external e.m.f. When stray electric currents escape from tramways, electric railroads and power circuits generally, extensive damage may result because

(1) The rate of attack is independent of the rate of oxygen supply and is determined solely by the strength of the stray current.

(2) The corrosion products deposit at considerable distances from the site of attack and do not stifle the reaction.

(3) If there are breakages in any protective coatings applied the activity may merely be concentrated on a few places and bring about speedy perforation of the pipe or plate.

Hayman[7] mentions a case in which intense corrosion followed the leakage of current from a tramline to a gas main, thence to a water main, and finally back to another tramline. The British Post Office has devised special methods for dealing with difficulties brought about by the same kind of mechanism in telephone cable-sheaths.

Electrolysis can cause deterioration of metal-work above ground, notably when stray currents are passing in steel embedded in concrete which has been mixed with water of high salt content; in electrical equipment where insulation is faulty or the earthing unsatisfactory and on board ship where paint has been removed, *e.g.*, by friction while launching.[8] It need hardly be said that electro-chemical corrosion of all types is stimulated by contact between metals and sea-water, and it would be instructive to know, if that were possible, exactly how much fuel has been consumed in the construction of new ships and in repairs to hulls and replacements of propellers and condenser tubes necessitated for that one reason alone.

Graphitic Wastage and Impingement

We have not the space to discuss the many and diverse physical appearances exhibited by metals under the influence of corrosion. Nor is this necessary since they all spring from the same root causes, singly or in combination. A glossary of terms commonly used to describe the effects of corrosion is given in a recent paper by Turner.[9] Reference may usefully be made, however to the phenomena of graphitic wastage and impingement which may be responsible for failures of economiser tubes and turbine blades respectively. When cast iron undergoes graphitic wastage, the metal becomes anodic and is dissolved out by the water leaving a brittle skeleton of graphite. The dangerous feature is that the corrosion can escape notice if an inspection is perfunctory and sound metal may be thinned down to bursting point before it is detected. The protective oxide film on turbine blades is impaired by impingement from droplets of water travelling at high velocity and so corrosion is accelerated. Similar conditions can exist in condensers and in high pressure heating systems.

Prevention of Corrosion

The principal methods for prevention of corrosion all derive naturally from a study of the main corrosion mechanisms. They are designed primarily with one or more of the following objects in view:

(a) To consolidate and repair the protective oxide film.

(b) To replace the oxide film by another of greater durability.

(c) To eliminate the influences which might cause the breakdown of protective films.

(d) To neutralise an electrical condition which might lead to electrolysis.

(a) *Consolidation and repair of oxide films.*—The work of Vernon and Murray, *inter alia*, proves that the early environment of newly-fabricated equipment has a vital bearing on its subsequent resistance to corrosion. It should not be difficult to arrange for the "curing" of plant parts, piping and machinery in a dry, dust-free atmosphere until the oxide film is strong enough to stand fairly rough usage. There is scope for considerable research on this subject which should lead to a marked extension in the useful life of manufactured articles.

Small percentages of metals such as chromium and nickel when introduced to iron and steel, or aluminium to brass, promote a surface film of mixed oxides more closely grained in texture and more firmly adherent to the underlying metal, and when this can be done without detriment to the usefulness of the product in other directions an increase in the cost of manufacture may be well worth while. The aluminium brass which was produced by a team working under the direction of the late Guy Bengough must have saved the Admiralty enormous sums of money besides making it possible to keep warships in service for longer pediods. While we must take note of Turner's view[10] that there is no likelihood of a "cheap completely corrosion-resisting boiler steel," there still remains a very large potential field for alloy development in the fabrication of the heavier classes of industrial equipment.

The principle of mixed oxide film formation may be applied from the outside, so to speak, for the protection of metals in contact with water by treating the water with a soluble salt of a suitable metal. Perhaps the best known example is the use of chromate and dichromate for the inhibiton of corrosion of steel under water. It is believed that chromic oxide is deposited at anodic points by electro-chemical agency, and this carries out repair work at any weak places in the original iron oxide film.[11] There are widely different opinions as to the concentration of chromate required for this repair work, and Murray[12] has shown that much depends upon the initial cleanliness of the equipment to be protected. He has had satisfactory results at concentrations as low as 10 parts per million under favourable conditions and after effective detergent action, but it seems, for the present at any rate that the method must be largely confined to systems in which the water is re-circulated and that the chromate concentration must be much higher than 10 p.p.m. All authorities are agreed that chromate treatment is attended by certain risks and that the rate of corrosion may actually be faster if the salt content of the water is too high. It is a defence weapon to be employed with discretion by a competent practitioner.

Metallic Coatings

(b) *Protective coatings.*—Many kinds of protective coatings are employed for the treatment of steel structures and others are constantly under investigation. Among non-ferrous metallic coatings reference may be made to aluminium, cadmium, chromium, cobalt, copper, lead, nickel, silver, tin, and zinc, and the application processes include hot dipping, cementation, electroplating, metal spraying, and metal cladding. In America, rare metal plating is on the increase and tantalum especially seems to have a bright future for vessels used in the luxury trades, *e.g.*, perfumery, and cosmetics. Glass, rubber, and vulcanite linings also become more popular year by year. None of these artificial films and coverings have been entirely satisfactory for protection of metals throughout steam installations or other plant where water is passing at high temperature and pressure and where thermal stresses may be severe. Graphite paint and cement washes have been applied with a fair measure of success to water distribution pipes, storage tanks, internal surfaces of boiler drums, and other accessible parts. It is imperative that any protective coating should be uniform otherwise intense local attack is likely, and, as a corollary, the surface to be protected must be reasonably clean and free from corrosion products before the coating is put on.

(c) *De-aeration and elimination of corrosive impurities.*—We have seen that the affinity of iron for oxygen is the ultimate cause of corrosion in nearly all cases, and it follows that if oxygen is eliminated from the environment the metal will remain unchanged almost indefinitely. This approach is manifestly impracticable for the protection of structures in air or underground, but the removal of oxygen from water can be accomplished either by mechanical or by chemical processes, and is perhaps the most positive step that could be taken for the inhibition of corrosion in

steam plant. The modern mechanical de-aerator is an extremely efficient piece of apparatus; it has been described in detail in *The Steam Engineer*[13] by the present author. For large water consumers mechanical de-aeration is the answer *par excellence*, but the smaller plant owner may not be able to afford the capital cost or to justify it in relation to the magnitude of his corrosion problem. Sodium sulphite can be employed as the sole agent for oxygen removal, but has the following serious disadvantages. Skilled control and frequent testing are essential in order to cater for variation in oxygen content; the method is expensive when dealing with raw water fully saturated with oxygen; dosing arrangements must be effective and reliable and the period of residence after the addition of sulphite must be long enough to allow the reaction to go to completion. This usually means plant of some kind. Certain metallic salts, *e.g.*, manganese sulphate when added in very small quantities, accelerate the absorption process, but even with their assistance the author considers that the period of residence should not be less than 30 min. when O_2 exceeds 1-ml. per litre; addition of sulphite increases the total solids of the feed water which involves a corresponding increase in the percentage blowdown from boilers in order to keep the density within permissible limits. As an example, water saturated with oxygen demands $\frac{3}{4}$ lb. of sulphite per 1000 gal., which would increase the total solids of Glasgow water by more than 100 per cent.

Influence of Acids

Other oxygen absorbents have been proposed and claims have been put forward by many writers, *e.g.*, by Fager and Reynolds,[14] for the absorption value of alkaline tannates, but sodium sulphite still retains pride of place for this purpose. The adverse influence of acids in general, and of carbon dioxide in particular, can be offset in water-carrying installations by the maintenance of a slight but definite alkalinity, and by control of *p*H value.

Although CO_2 is the only acidic impurity found in all natural waters, others occur locally. Sulphuric acid is fairly frequent in mine drainage water through contact with pyritic seams, and strong mineral acids are often discharged as waste liquors into rivers and canals. In industrial districts traces of sulphur gases can be picked up from the atmosphere. Moorland supplies contain organic acids and so does the effluent from sewage disposal works. Hence, it is no exaggeration to say that the first duty of every water treatment chemist is to make sure that a slight but definite alkalinity of the right kind is maintained at all times. The alkaline reaction must be definite in order to prove that the acids have been destroyed and to allow a reasonable margin for experimental error in making the test and variation in raw water quality before the next test is due. It must be slight because excess alkalinity is undesirable in many industrial processes, and particularly in steam generation. Twenty to 50 p.p.m. of alkalinity expressed as $CaCO_3$ is widely accepted as a practical working standard. The alkalinity must be of the right kind in order to neutralise acid tendencies arising from the breakdown of bicarbonates when the water is heated. Obviously any alkali which is liable to decompose and produce an acid at high temperature would not be suitable as an anti-corrision treatment for steam plant. The reasons for preferring one alkali to another for specific purposes are closely connected with questions other than corrosion which are outside the scope of the present paper.

The touchstone by which one decides whether alkalinity in boiler feed water is of the right kind or not is the test for *p*H value. If the *p*H is above a certain critical value there are sound reasons for expecting immunity from attack from CO_2. The symbol "*p*H" stands for "the logarithm of the reciprocal of the hydrogen ion concentration." Hydrogen ions are characteristic of acids and low *p*H indicates a strongly acid tendency. In water, the perfect neutral compound, hydrogen ions are exactly balanced by hydroxyl ions and the "strength of alkalinity" could be expressed in terms of the hydroxyl ion concentration. But since the hydroxyl ion concentration must necessarily be inversely proportional to the hydrogen ion concentration, it is more convenient to express both acidity and alkalinity in terms of one kind of ion. It is important to bear in mind that *p*H value does not measure the total acidity or total alkalinity, but merely the number of free H ions in solution. It is an indication of intensity rather than quantity, the relation being much the same as that between temperature and heat, or between voltage and electrical energy.

Aggressive CO_2

*p*H control for prevention of corrosion was put on a quantitative scientific basis by Langelier[15] and De Martini.[16] They classified CO_2 in water supplies as being of four kinds: CO_2 permanently combined as carbonate; CO_2 temporarily combined as bicarbonate; CO_2 required to stabilise bicarbonates in solution; excess CO_2 over and above these.

Only the fourth kind, they said, is active or aggressive CO_2, and Langelier proposed an elementary test to show whether CO_2 of the last kind is present or not. The *p*H value of the water is tested before and after stirring with powdered chalk. If the *p*H of the raw water is increased by the

addition of chalk, Langelier's Index has a negative value equal to the difference between the two results, and the water is corrosive in correspondng measure. Conversely, if the pH value is reduced by the addition of chalk, the index is positive and the water is assumed to be non-corrosive—*e.g.*:

pH raw water	pH after stirring with $CaCO_3$	Langelier's Index	Character of water
6.5	8.0	—1.5	Corrosive
7.8	7.5	+0.3	Non-corrosive

Langelier points out that when his index is positive, any tendency towards galvanic action must result in the deposition of the $CaCO_3$ at anodic points; thus the theory takes into account to some extent the old carbonic acid cycle and the newer theory of D.A. as well as the principles of protective film formation and neutralisation of acids.

In my view the index can be usefully employed in the control of treatment for cold water circuits, but in parts of the plant where pH is constantly changing due to loss of CO_2 decomposition of bicarbonates and precipitation of Ca and Mg ions, it is easier and safer to ensure that the pH is high enough to satisfy Langelier's hypothesis under the most severe condition which could possibly arise in the plant, and, that being so, all one needs to do is to arrange that the pH never falls below 9.0. The prospect of $CaCO_3$ forming a protective scale seems to disappear when phosphate conditioning is in force, and no form of pH control can be relied upon to stop attack by dissolved oxygen.

Colloidal Preventives

Other inhibitive measures for treatment of water to prevent corrosion besides those mentioned above include the use of colloidal substances such as starch and silicate of soda. It is known that colloids have a high adsorption capacity for gases owing to the enormous surface area presented by particles of sub-microscopic size, but the method is somewhat uncertain, and a more direct attack on the problem such as that offered by de-aeration and removal of CO_2 by treatment with lime is preferred when practicable.

(d) *Prevention of electrolysis.*—Although corrosion of steel by electrolysis is possible on above-ground structure, it is a more serious problem in connection with underground pipe-lines and cables. Not only is the likelihood of picking up stray currents far greater and opportunity for inspection much more restricted, but the acids present in many types of soil often cause extensive deterioration of insulating material, protective coating and wrappings. Attack is then intensified at the weak spots. Insulation is usually attempted by dipping the pipe in bitumen, coal tar or cement, by coating with zinc by the dip or spray process and by wrapping with various materials impregnated with tar or asphalt. Insulating joints have been employed with striking success by the British Post Office. The method of jointing for protection of pipes has been described by Steinrath and Klas[17] and for cable sheaths by Radley and Richards.[18] The method is a long way from foolproof, and if the number of joints is inadequate or if they are wrongly situated, defects may be multiplied by the creation of anodes and cathodes on each side of the break (Evans[19]).

Sacrificial Anodes

The use of sacrificial anodes has been described by Jeavons and Pinnock.[20] Numerous iron bars sunk in the ground in moist places (specially prepared if need be) were connected to the pipe-line after taking precautions to ensure good electrical contact between the sections over the entire lengtth of pipe. Particular care was exercised to make the covering as perfect as possible. The iron bars thus became the true anodes of the system and suffered rapid corrosion, but the pipe was preserved in excellent condition. In passing we may note that the idea of sacrificial anodes is a very old one—it is at least as old as the use of zinc plates in boilers! The most modern method of combating electrolysis in underground pipe-lines and one which appears to present the possibility of wider application than any other so far proposed, is known as cathodic protection. Schneider[21] has given a most instructive and enlightening account of the process from which the following passage is quoted: "Cathodic protection protects a pipe by sending an electric current from an outside source to the pipe through the weak spot in the pipe wrapping or to the surface of the bare pipe, neutralising the electric currents that previously discharged from the surface and caused corrosion.

"To protect a pipe or other structure cathodically the compensating current must be caused to enter the pipe through the soil. This is accomplished by connecting a source of direct current, to cause a current to flow from the auxiliary electrode, pilot pipe or anode, to the main being protected. When the adjustments of the protective current are properly made, all corrosion of the pipe-line in the area is completely prevented. The corrosion that previously took place on the main line has been transferred to the ground electrode. Preliminary tests are made to determine the capacity of the direct current supply required to protect a given line. The source of current for this test current is usually a portable storage battery, a portable gasoline engine-driven direct-current

generator or a portable welding generator. If a convenient source of power is available a temporary motor generator set or a rectifier installation can be used.

"The positive terminal of the battery or other source of direct current is connected to a temporary low-resisance ground through an ammeter and a rheostat. The negative terminal is connected to the pipe to be protected. Holding the current at a constant value during the test, soil current readings are taken at several points and at the limits of the positive or corroding portion of the pipe-line. In the positive areas the soil current will be found to be reduced or even reversed if the protective current is great enough. It is desirable to repeat this test for several values of battery current.

"When the earth current readings are plotted at a given location against the battery output a nearly straight line will be obtained. This is used to determine the value of protective current required. The value of protective soil current required, in milliamperes per sq. ft. of pipe surface, as indicated by the McCollum earth-current, meter, can be determined approximately from the empirical equation:

$$i = \frac{1000}{r}$$

in which

i = current in milliamperes picked up by pipe per sq. ft. of surface exposed to soil;

r = specific resistance of soil in ohms per cc., as given by Shepard rod, McCollum meter or laboratory test with a-c. bridge

1000 = constant, including a safety factor of three, found in laboratory tests on sheet steel. The safety factor compensates for inequalities in the steel, differential aeration, contact with other elements in the soil, such as coke, metallic areas, etc.

"The advantage of this equation is that it requires few or no additional tests to obtain the necessary information on which to determine the minimum current required, and is convenient and sufficiently accurate for practical field use."

Schneider stresses that electrolysis occurs only at points where current can escape from the pipe and that entering currents actually protect a metal at the points of entry. The signal advantage is claimed that by cathodic protection defects in the ordinary coating and insulators can be overcome without excavation of the line, an expensive and inconvenient operation under concrete pavements in busy city streets.

Conclusion

Corrosion and its prevention is a science in itself, and it would be idle to pretend that we have done more than to survey the subject very briefly in this paper. The object has been not so much to study any single aspect in detail as to show that methods are in existence to deal effectively with almost every corrosion problem. It is hoped that the industrial public, perceiving the broad outline of prevention technique and appreciating the intimate relation between corrosion mechanisms and protective measures, will gain confidence in the ability of the experts to solve its problems and will recognise that money spent in carrying expert advice into practice will, in most instances, be regained many times over.

As it becomes more widely realised that protection is cheaper than replacement, the amount of fuel consumed in new manufactures, repairs, and maintenance, or wasted by avoidable stoppages will be reduced and so the nation will gain while the individual helps himself. If it is true as Watt states that corrosion results only in loss and never in profit, then surely the converse likewise holds good with reference to corrosion prevention.

The author recorded his indebtedness to various experts for advice and information.

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American Research on Germanium

Important Commercial Uses Found

by WILLIAM BULL

PRODUCTION on a commercial scale of the metal germanium and its dioxide is one recent application of research in the U.S.A. Costs have been notably reduced as a consequence of the investigations at the Battelle Memorial Research Institute in conjunction with the work of E. W. McMullen, Director of Research at the Eagle-Picher Lead Company's Research Laboratories. The future applications of germanium promise important developments, but large supplies will not be available in the near future, as although the metal was produced a month ago in commercial quantities, this was largely preempted.

Germanium is less refractory than silicon, is intermediate between silicon and tin in alloying facility, while glasses containing the dioxide possess greater refractivity, dispersion, and density, lower softening points, and greater viscosity than those with SiO_2. Demand for germanium arises from its applications to radar, from its exceptional properties as applied to design of film resistors and from the remarkable character of two notable alloys which expand slightly on cooling with consequent application to small-scale precision casting, *e.g.*, the use of the binary Au-Ge eutectic in dental inlay work. Now, thanks to the development of a method of production on a larger scale, it is likely that the industrial sphere of germanium will be progressively developed. A Société Française Radio-Electrique patent of August, 1939, for example, relates to a cathode material, containing 74 per cent Al, 2i Ge, 2 Fe, 3 Si, useful for electron tubes because of its strong secondary emission of electrons, while a U.S. patent of January, 1929, enters the sphere of germanium high-restivity film deposit in Pyrex or dense ceramic tube resistors. Recently in this field of high-restivity germanium films the Battelle Institute has worked out a method by which the films, to gauged amount and even distribution along tube interiors, can be systematically duplicated.

Film Deposition Methods

Film-deposition methods are interesting and comparatively simple and can be accomplished by passing germanium hydride in gaseous form, resulting from temperature applications about 370° C., through tubes of appropriate material. A mixture of 30 to 50 per cent of GeH_4 is prepared by treating magnesium germanide (made by heating two parts magnesium filings with three parts germanium powder to red heat in a hydrogen atmosphere) with dilute HCl. The deposition on glass, for instance, according to the Battelle method, follows by admitting definite amounts of a hydride-hydrogen mixture into the evacuated tubes. The tubes are then evenly heated to 400-450° C. at the film-deposition location, when a silvery grey film then appears. Concentrations of 25 per cent hydride to 75 per cent hydrogen are recommended; higher percent-

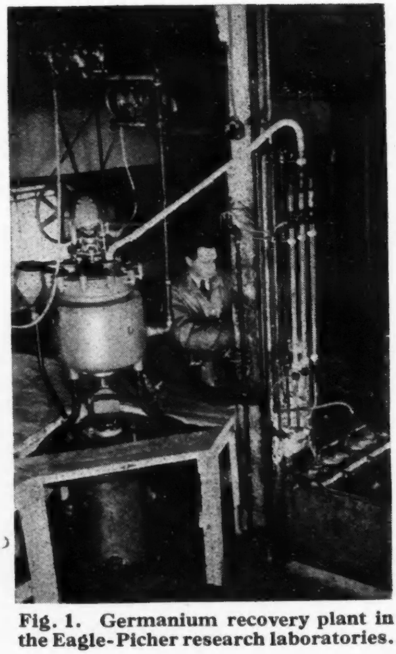

Fig. 1. Germanium recovery plant in the Eagle-Picher research laboratories.

ages of GeH_4 furnish a deposit liable to flake. The Pyrex tubes are heated as described for 10-25 minutes, an adherent uniform film resulting.

Germanium film resistors possess exceptionally high resistivity, measured over a 2.5 cm. length of 7 mm. Pyrex tubing. Resistances range from 1000 ohms upwards, according to deposition conditions, while temperature coefficients vary only from 0.001 to 0.003/1° C., even lower temperature coefficients are obtained with silvered tubes. Germanium and silicon as semiconductors have rectifying characteristics, and research on germanium applied to radar rectification of micro-waves has, during the war, been intensively carried out at Purdue University. The Cornelius germanium-crystal rectifier, type IN34, will, it is claimed, permit higher inverse peak voltages, thus a potential field of use is envisaged in voltage regulators, low frequency oscillators and polarising apparatus. In this rectifier a tungsten wire is in contact with low-tin germanium alloy wafers, 0.015 in. thick.

Other applications of germanium, as distinct from certain rather important alloys, possess points of interest, but at this stage seem unlikely to assume industrial importance. Sources of Ge include germanite, found in S.W. Africa, but this sulphide, containing 6 per cent Ge, was reported to be "depleted" in 1942. The oxide is known to occur in Britain and Russia to around 1 per cent in coal ash and flue dust and it is noted that this could be an adequate source of supply if extraction costs could be justified. Extraction of germanium is usual through distillation of $GeCl_4$, obtained by treating ground ores or residues with HCl, the resultant tetrachloride is hydrolised to GeO_2, filtered out and ignited. Reduction to the metal is complicated by the fact that the use of molten chloride fluxes is necessary to avoid loss through the volatile GeO. There are other methods, but that reported as preferable is reduction to fused mass by carbon, or cyanide and carbon, under molten sodium chloride flux; oxide or oxygen is present, and elimination is by repeated melting and freezing in hydrogen, or by vacuum treatment while molten.

The Eagle-Picher Company, which developed the industrial scale process in response to radar demands, are reported to be the world's largest producers to-day. Their prices, in U.S.A., were recently 50 dollars a pound for the oxide and 180 dollars a pound for the metal. This company's maximum production is around 2,000 lb. yearly, governed by the amount of cadmium residues becoming available from their plant.

Recovery at the Eagle-Picher plant is a particularly interesting industrial process, developed during the war period and the result of considerable research. Mr. McMullen is the company's Director of Research and the writer is indebted to him for the photo-

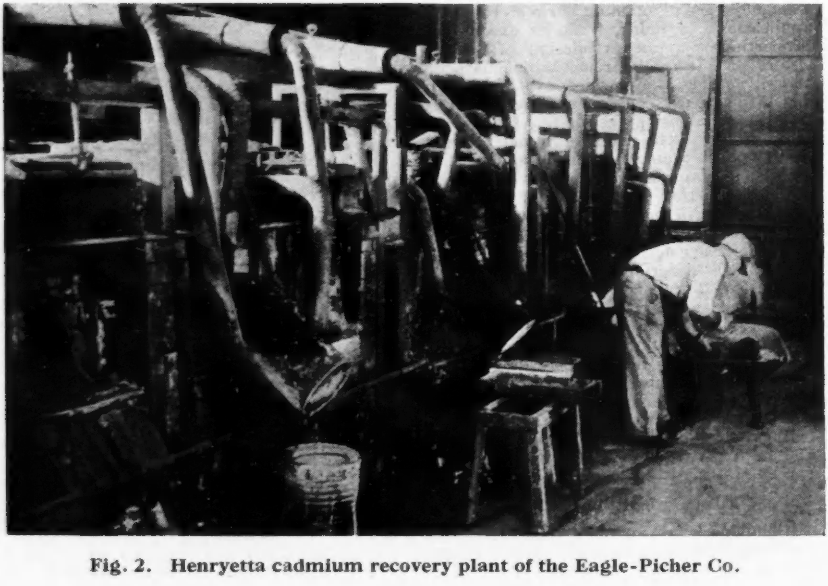

Fig. 2. Henryetta cadmium recovery plant of the Eagle-Picher Co.

graphs taken especially to illustrate this article. Spectroscopic analyses revealed that germanium was concentrated in the fume produced in sintering zinc concentrates. At the Cadmium Recovery Plant, this fume is dissolved in sulphuric acid and cadmium is separated from other metals. Through spectroscopic analyses the greater part of the germanium can be concentrated in specific residues. The prepared residue is then forwarded to the Joplin Research Laboratory, it is here distilled with excess strong (at least 31 per cent HCl) acid. The distillate, volatile $GeCl_4$ and chlorides of certain other metals, are collected in ice-cooled containers. A subsequent somewhat complicated treatment of the tetrachloride results eventually in a pure, water white, spectroscopically pure tetrachloride. Germanium hydroxide is then produced by hydrolysis. One volume $GeCL_4$ is diluted to five volumes by ammonia solution and hydroxide is precipitated in the next twenty-four hours. It is then washed, filtered and dried at 150° C. to form the dioxide. Reduction of the dioxide with sodium cyanide, and carbon, at 1200° C. gives a 99.6 per cent purity, or by hydrogen at 900° C., when a high laboratory degree of purity is required.

Certain alloys, notably gold-germanium and copper-gold-germanium eutectics appear to possess important characteristics. Wide investigations into the various systems, including gold-germanium ternaries, have been made, and efficient applications of the Au-Cu-Ge alloys include soldering of gold base alloys, using standard fluxes and heating treatments. These alloys, which expand slightly on cooling, possess a hardness of 200-300 v.p.n. and strength of around 55,000 lb. per sq. in. Germanium does not react with carbon so that it may be melted in graphite crucibles and the gold —12 per cent germanium eutectic, of a gold colour, has the low melting point of 356° C., exceptional qualities for precision casting and excellent soldering propensities for gold alloys or gold plated articles. Silicon provides a similar alloy but is extremely difficult to dissolve in molten gold, moreover the Au-Si eutectic, owing to easy drossing, is difficult to handle in soldering. The binary alloys are of fine micro-structure and, up to 92 per cent gold, expand on solidification and even at this percentage will crack glass containers on cooling. This property is valuable; for example, an experimental dental inlay, made without the customary correction for shrinkage, has, without detectable corrosion or other disability, been in personal service now for somewhat more than a year.

The main points of present commercial or industrial application have been outlined here, but further investigation may reveal other developments in sources, production and processes of germanium or its dioxide.

Iron and Steel Output

U.K. Figures for September

THE production of both pig iron and steel in the U.K. during September was at a higher rate than during August, according to figures issued by the Ministry of Supply, although steel production was curtailed because of a Scottish labour dispute which involved furnace bricklayers. The tables below show how the position compares with last year, all figures representing tons:

PIG IRON

	1945 Weekly average	1946 Weekly average
First quarter	134,500	145,500
Second quarter	132,600	150,500
Third quarter	132,600	146,600
August	122,300	145,300
September	139,300	147,300

STEEL INGOTS AND CASTINGS

	1945 Weekly average	1946 Weekly average
First quarter	233,200	242,600
Second quarter	227,200	252,100
Third quarter	211,300	230,000
August	182,000	225,900
September	240,700	238,500

Scottish Minerals

Resources for a Light Alloy Industry

LAST week, in a paper on "The Industrial Development and Rehabilitation of the Highlands," read to the members of the Town and Country Planning Association (Scottish Section) at their conference at Dunblane, Dr. G. D. Muir, F.R.I.C., chairman of the Scottish Area Committee of the A.Sc.W., said that limestone and dolomite deposits in the Highlands could be transformed on the spot into such useful products as synthetic rubber, plastics, fertilisers, and light metals. Limestone was one of the chief mineral resources of the Highlands, while the 300,000,000 tons of high-grade dolomite lying around Durness and Loch Eriboll, in Sutherland, provided a source of magnesium.

There were sound technical reasons, he said, for establishing ferrosilicon and magnesium industries in the Cromarty Firth area. Power could be supplied from Ross and Cromarty hydro-electric stations, while existing aluminium plants in Inverness-shire could supply aluminium to facilitate developing a light alloy industry.

A sum of £830,000 is to be spent on development plans in Basutoland within the next ten years.

Training of Good Metallurgists

Dr. T. Wright's Presidential Address at Birmingham

"THE University Training of a Metallurgist" was the title of the presidential address which Dr. T. Wright gave to Birmingham Metallurgical Society on October 24, after he had been inducted president by the immediate past-president, Dr. J. W. Jenkin, to whom Dr. Wright presented the silver medal of the society.

In his address, Dr. Wright, who is a Lecturer in Metallurgy at Birmingham University, recognised that, however balanced a university course might be, it was a compromise in the sense that the field covered could be a small part only of the subject. He said a university had to train men for a wide variety of jobs between the extremes of works management and pure research in the laboratory. In the past one single comprehensive course trained a man for both production and research, but the type of research for which he was equipped was restricted mainly to that concerned with industrial problems.

There was no commercial organisation which clamoured for men trained to do research on problems of a fundamental scientific nature but there was a real need for such men if the nation was to keep in the forefront of scientific development. Industry gained in the long run from discoveries of a purely scientific nature. When atomic energy became available as a source of power for industry and mankind in general it would be as a result of the work of pure scientists.

The Department of Metallurgy in Birmingham University now provided a comprehensive course for training research workers in metal physics, or theoretical metallurgy. It was a new venture and he believed that Birmingham was, as yet, the only university to offer such a course. A parallel specialised course in industrial metallurgy had also been inaugurated in Birmingham to cater for that larger group of students wishing to follow a more orthodox metallurgical career. This new venture offered a training for industry far more adequate than when one course fulfilled a dual role. The industrial course, in which students learned something of the economic side and works organisation, must be regarded as the more important.

The student's first year was a general preparation in the pure sciences. He then studied metallurgy for two years; and specialised in his final year either as a theoretical or an industrial metallurgist. The final stage for the latter must be in the works which employed him. Dr. Wright showed how practical work was extended to industrial production processes during vacations and by visits to works, for which they were grateful to industry. The new Department of Industrial Metallurgy would be equipped with plant enabling students to handle metals on a scale more comparable with industrial operations.

Referring to essential subjects outside metallurgy—physics, chemistry and mathematics—Dr. Wright said: "The type of metallurgical training now necessary demands a much higher intellectual standard in the student than it has in the past. To be able to make the grade in the new courses at Birmingham he must be equal to the best type entering for degrees in physics or mathematics. One of our greatest difficulties will be to attract sufficient young men of high mental calibre. It is natural that when a boy comes to the university he prefers to study a subject with which he is familiar. An hour's talk by some suitable person to senior boys before leaving school could do a great deal towards introducing the fascination of the subject and its possibilities as a career."

A broader cultural education would increase the technical specialists' usefulness to the community and their own personal enjoyment of life, but it must be voluntary. Employers preferred metallurgists to be "good mixers" and that, though inherent in personality, could be fostered in the university. Associated with it was the knack of winning the confidence, respect and cooperation of workmen.

NON-FERROUS SCRAP

The Ministry of Supply states that the Government's stock of non-ferrous scrap metals on charge on September 30 totalled 183,752 tons, made up as follows: Q.F. cases muffled S.A.A., 85,658 tons; ingots, 17,993; lead and lead alloy, 1503; copper and copper alloy, 20,082; zinc and zinc alloy, 12,666 tons other grades, 45,850. Sales for August and September amounted to 18,286 tons (approximate value £910,000).

COPPER CONSUMPTION

U.K. output of main copper and copper alloy products in September was 53,954 tons, of which copper content of output was 42,510 tons. Output of unalloyed copper was 24,097 tons, alloyed copper 26,121 tons, and copper sulphate 3736 tons.

Fuel Saving in Metal Making*

Diverse Operation Methods

by LESLIE AITCHISON, D.Met., B.Sc., F.R.I.C., F.R.Ae.S.†

NON-FERROUS metals, and still more the light alloys, do not call for particularly high temperatures in the course of their fabrication. Copper with a melting point of 1084°C. or aluminium, melting at 657°C., indicate the order, and even allowing for a reasonable measure of superheat the highest temperatures ever likely to be employed during the manufacture of these metals and their alloys are considerably below those needed in the melting—or even the forging—of steel. This fact widens the fuel possibilities considerably. It makes the choice of fuel easier, in many respects, for the brass founder than for the steel maker. It may even be admtted that the non-ferrous manufacturer has been able to "make do" with fuels of a lower grade than his ferrous brother—though not necessarily to his advantage. More importantly, though, his lower temperature requirement means that in most cases the amount of fuel used in a comparative operation is likely to be considerably less for the non-ferrous and light metals than for cast iron or steel.

Comparative Fuel Costs

A second point having an important bearing—at any rate on the psychology of the matter—is that the non-ferrous metals and the light alloys are all metals of a relatively high money value as compared with iron and most steels. Taking virgin metals alone, the mixture prices on to-day's markets for 60/40 brass, 70/30 brass, gilding metal, and duralumin are respectively £67, £71, £80, £75 per ton, as compared with £8 15s. per ton for pig iron. When these values for the non-ferrous metals are compared with the price of the fuel required to melt them and a similar calculation made for pig-iron—and of converting the iron into steel—the disparity becomes very obvious and indicates that as an item in the fabricating bill fuel pays a much smaller rôle in the non-ferrous than in the ferrous world. Nevertheless, it must not be inferred that fuel economy is of but little importance to the manufacturer of non-ferrous metals.

A third aspect deserving of mention is that of scale of operation. For a variety of reasons the range in the size of melting furnaces is quite extensive. In a copper refinery the melting unit is large, and, for certain purposes, brass can be handled in big masses—up to 20 tons for a furnace charge. But such installations are by no means general in the trade, due to its particular nature, and a great many fabricating concerns melt their alloys in furnaces of quite small tonnage capacity. The employment of electric melting, particularly in the low-frequency induction furnace, bringing with it advantages in handling, cleanliness, and quality, has made the melting unit in popular use rather small—not more than about a ton, and many firms concerned with quite a considerable output of copper alloys produce their castings by a multiplication of units of modest dimensions rather than by installing fewer units of large capacity. The position is not quite the same for the light alloys, and for wrought manufacture large furnaces are quite generally used—of, say, 10 or 12 tons capacity. It is rather early yet to say whether this practice will persist, as on the score of economy and of metallurgical quality smaller melting units are finding a good deal of favour. These smaller units may be fired with electricity or gas or oil, while the larger units, being of the reverberatory type, usually employ solid fuel, either directly employed, or through gas producer units. A comparison of the fuel consumption given by one firm using both methods shows about 80 therms per ton for the solid fuel used in a large furnace against 33 therms per ton of town's gas in a furnace of only 10 cwt. capacity. Taking the two industries it is evident that the range of furnaces used is wide, but that, and particularly in the non-ferrous industry, small units are far more numerous than large, and since they are balanced with the units of fabricating plant in a large number of factories they are likely to be a persistent feature in the trade.

Furnace Conditions

The important matter of finish and surface quality of non-ferrous materials accounts for the attention paid within the industry to the effect of furnace atmospheres and conditions upon the metal. In the non-ferrous trades it is rather unusual for metal to be delivered in any but a reasonably bright state, though in the case of rods and sections made by extrusion the brightness is not a real necessity. The conditions for this finish demand not only a suitable atmosphere within the furnace but also a reasonably rapid rate of heating (except for certain precipitation treat-

* From a paper "Fuel Considerations in the Fabrication of Non-Ferrous Metals and Light Alloys" presented at the Conference on "Fuel and the Future."

† Professor of Industrial Metallurgy, University of Birmingham.

ments) so as to reduce to the minimum the time of exposure of the surface of the metal to the influence of hot gases. Combined with this relative rapidity of heating, accuracy of temperature control is of considerable importance in all reheating operations, the non-ferrous metals being particularly sensitive to the effect of variations in temperature and time of exposure.

Problems of Fuel Economy

In view of all these factors we may begin to see what is involved in a determination of the best way to utilise available fuel and how it is to be made to go farthest. The industry has to produce a large variety of alloys, all fairly highly priced; in a multiplicity of forms and tempers; from a considerable number of relatively small production units (*i.e.*, items of plant); to conserve the alloys during manufacture; and to work at comparatively moderate temperatures. It follows therefore that a number of factors must be taken into account in the endeavour to achieve the desired results in the most economical manner. For the question of fuel economy cannot be taken just by itself. It might well be that a reduction in actual fuel consumption in a certain process could be achieved by a complete change of heating method. But would that change be really economical? Would it reduce the total production cost of the material, or might it, by increasing labour costs, by incurring heavy capital charges (and therefore the earning of depreciation) for buildings and equipment, actually result in an increase of total cost while reducing that relatively small item for fuel that characterises the non-ferrous industries' production account? On the other hand, will a change of method of melting and reheating bring with it certain compensating savings in another direction? Will it, for instance, reduce the actual loss in melting? Will it reduce the oxidation or scaling in reheating? Will it bring down the labour cost? All these factors have to be examined.

It is not surprising that in the non-ferrous field there is a considerable diversity of practice and a variety of modes of heating, for casting, for reheating, and in the course of subsequent working. It is fairly safe to say that for a very long time these industries did all their melting in pit fires, fed with coal or coke, in such crucibles as they could command, and that the annealing or reheating was achieved in ovens or simple in-flame furnaces, using coal or much less frequently, coke. The transition from this relatively primitive practice is by no means yet complete—nor is there any particular reason why these old practices should be abandoned entirely so long as they are refined and polished. Where the production is that of a single—or nearly single—material, the pit fire shows itself to be rather more expensive in fuel than electric melting, but the latter method implies a greater capital expenditure, a continuity of production, and regularity of product, if this possible saving in the fuel cost is to be secured. So the pit fire is still with us, and is likely to stay—for many purposes. But it may be modified—for certain practices—into the tilting crucible type of furnace, which may employ as fuel either oil, creosote, pitch, coke, pulverised coal, or town's gas, the two first mentioned being the most common. In these furnaces the crucible size is usually considerably greater than with the ordinary pit fire. This presents both advantages and disadvantages, and whether one outweighs the other depends a good deal on the metal that is being melted, the sizes of ingots to be made, and the throughput of the factory. In view of this variety of practice which exists within the industry to-day, it is hardly surprising that there is quite a marked diversity in the actual amount of fuel consumed per ton of metal melted, even when it may be assumed that all the manufacturers are doing their utmost to use as little as possible.

Research Into Fuels

When searching for the practical answer to the problem of the ideal process (which means the proper combination of furnace and fuel) it seems that many considerations must be examined. Research on a fairly wide basis might well be undertaken, in the first instance by a statistical examination of the data that could be collected from existing practice. The opening out of the fuel position following the development of oil and of creosote pitch to economic success suggests this research programme may go much further, particularly if the price of other forms of heating rise. The admirable results obtained with gas heating (which is a form using less coal from the pit than electricity) suggest too a line of inquiry that might well be fruitful. When this is directed also to the ideal of utilising all the heat, by recuperation, preheating, or in other ways, the scope is great. But it must be emphasised that the problem is not purely that of the furnace designer, but one in which he must co-operate with the metallurgist so that the operating factors can be fully examined.

Concurrently, it seems desirable that the non-ferrous industries should take a leaf from the book of the steel maker and consider seriously the best way to utilise all the heat in the fuel and not waste it by letting it "go up the chimney." In the steel industry, preheating of air and gas by the use of recuperators is a regular practice. In the non-ferrous industries such practice is not so common, and is worthy of far greater attention.

Inevitably, in the non-ferrous field the mind of the producer turns to the conservation of metal in his processes. In the balance sheet metal loss may very easily be a larger item than fuel. If, for instance, it be taken that the cost of the fuel used in melting brass, of heating it for rolling, and of annealing it during cold rolling, amounts to, say, 26s. per ton *in toto*, a loss of metal in all processes greater than 2 per cent will outweigh the fuel cost. Metal losses can readily creep up and are almost invariably the by-product of heating operations, arising either from mechanical losses into the ashes, which may be recoverable but cost money in the process, or by the oxidation or volatilisation of the metals during the actual heating processes. Various factors promote this oxidation or volatilisation, and some are more potent in one process than another. In a general way, however, it may be said that the safest way to keep these losses to a minimum lies in attention to temperature, time, and atmosphere.

Carriers Promote Economy

In reheating operations there is little doubt that economy is promoted by the use of a furnace through which the material moves from the cool to the hot end, and this movement should preferably be effected automatically or mechanically. In the case of round billets or ingots the passage can be achieved by rolling through the furnace on an inclined floor, and this process certainly promotes uniformity of temperature within the metal. With slabs the progress must be achieved by a moving carrier of some kind or another, the less bulky the better. As the material is constantly passing out—at the requisite temperature—a good deal of heat may be lost at the furnace exit, by radiation or by convection, unless the doors are kept closed and fit fairly well. It is better for them to return automatically to the closed position when the billet or slab is withdrawn. Similarly, it is well to have the transit from the furnace to the press, or rolls, as short in distance as possible, and mechanised to the best advantage, so that the minimum time is occupied in transferring. It is also important to arrange that during any stoppage of the flow of metal through the furnace, the fuel supply shall be cut off—or, at any rate, suitably reduced. This affects both fuel consumption and metal losses.

In annealing, and particularly of sheets, one of the most important problems is to secure uniformity of temperature throughout the mass of metal within approximately the same heating time. This is always desirable for metallurgical reasons, but in addition usually has a bearing on the full consumption. A stack of sheets pushed into a furnace on a charger may, and generally does take a long time to heat through. This exposure is usually bad for the metal—promoting grain growth on the outer sheets through which the heat must pass, not to mention greater scaling. A long soaking for a proportion of the charge is almost inevitable with such an arrangement, and this does not promote a low fuel consumption. If the sheets must be stacked, the pile should preferably be interrupted by spacers and if this device be resorted to, there is a premium on air circulation within the furnace. This matter of circulation of the furnace atmosphere is one of general importance. A great measure of turbulence of the hot gases within the furnace is a good and useful feature, for either air or gas, if stagnant, acts as an insulator, and prevents that intimate contact between all parts of the charge with the source of heat which alone can bring about rapid, and therefore economic, heating. The alternative method of heating—not in stacks, but by passing the sheets through the furnaces on a moving carrier—obviates the soaking danger but brings other troubles with it, in particular the heat consumed and continuously lost in heating the carrier. As with reheating, so in annealing, the loss of heat through the doors may be quite appreciable and it is certainly important to arrange for rapid charging and discharging of the furnaces.

Effective Maintenance

Mention has been made of the utilisation of waste heat. This, of course, applies particularly to furnaces using liquid and gaseous fuel—whether town's gas or producer gas or oil. The recuperative principle is obviously a sound one, and, applied to such types of heating, will be definitely rewarding. One thing that stands out in most installations is the need for sound and effective maintenance. This ranges from such matters as the correct alignment and setting of oil burners at one end of the scale to the repairing of leaks in gas ducts or mains or furnace hearths at the other. In between, perhaps, comes the question of keeping flues, grates, and fire boxes clean. In the operation of furnaces—for all purposes—cleanliness is a supreme virtue. A dirty or a choked furnace can never be efficient. And here it may be interpolated that there is a vicious circle connecting fuel consumption and spoilt metal. Bad practice in the thermal operations may do great harm to the metal—either scrapping it entirely or rendering necessary a further treatment at high temperatures. In one case, both metal and fuel are lost, in the other a double (or greater) quantity of fuel is needed to achieve the requisite output. Money spent in ensuring the successful prosecution of a metallurgical operation is usually, in the long run, money saved.

U.S.A. Aluminium

Decline In Output

PRIMARY aluminium output in the United States in 1945 is estimated at 496,487 short tons, a decline of 36 per cent from the 776,446 tons produced in 1944 and 46 per cent below the record of 920,179 tons in 1943, according to the Bureau of Mines, U.S. Department of the Interior. There was a moderate production increase early in the year as a result of temporary military reverses on the western front in Europe, but output dropped steadily after May as the war drew to a close. All Government-owned aluminium metal and alumina plants were closed by October 31, 1945, leaving only the privately-owned plants of the Aluminum Company of America and Reynolds Metals Co. in operation.

Recovery of secondary aluminium in 1945 totalled 298,387 short tons, compared with 325,645 tons in 1944. It required the consumption of 323,676 tons of aluminum scrap, of which 10 per cent was old and 90 per cent was new scrap. Stocks of virgin ingot aluminium held by the Reconstruction Finance Corporation on December 31, 1945, totalled 185,750 short tons. Total stocks of primary and secondary aluminium held by producers, distributors, consumers, and the Government, plus that available from wrecked and obsolete aircraft, are estimated to have been more than 1,000,000 tons at the end of 1945. Apparent domestic consumption of primary aluminium in 1945 increased 7 per cent to 796,081 short tons (744,627 in 1944). This figure is somewhat inflated, however, inasmuch as Government stocks in the U.S. increased greatly during the year.

Record Imports

Imports of crude and semi-crude aluminium in 1945 reached a record level of 339,293 short tons, valued at $98,289,943, three times as great as the 1944 entries, according to the U.S. Department of Commerce. The tremendous increase was a result of war contracts between the U.S. and Canada. All the imports of crude metal, scrap, plates, sheets, and bars were from Canada, except for 589 tons of plates, sheets, and bars shipped from the U.K. Imports of aluminium (crude metal and alloys only) constituted 42 per cent of the apparent consumption of primary aluminium during 1945. Exports of crude and semi-crude aluminium during 1945 dropped to 6543 short tons valued at $3,064,240 from the previous year's peak of 188,521 tons valued at $73,578,734. Virtual cessation of Lend-Lease shipments of primary aluminium to Russia caused the precipitous drop in exports.

World production of primary aluminium is estimated at 916,000 metric tons in 1945 compared with 1,702,000 tons in 1944. The greatest decline in output was in Germany and the central and south-eastern European countries, where facilities were captured during the first four months of the year. Of the 1945 production, it is estimated that 49 per cent was by the U.S., 21 per cent by Canada, 9 per cent by U.S.S.R., 4 per cent each by France and the U.K., and 13 per cent by other countries.

U.K. Tin Position

Fall in Ore Stocks for September

A REDUCTION of nearly 1000 tons in the stocks of tin ore in the U.K. at the end of September is reported by the Ministry of Supply. Stocks totalled 8052 long tons, as compared with 9049 long tons at the beginning of the month.

Stocks of tin metal held by the Ministry on September 30 were 8738 tons, compared with 9267 tons at the beginning of the month, while stocks held by consumers at the end of September were calculated at 4237 tons and reported to be 3908 tons. There were no arrivals of tin metal during the month, but production is shown at 2507 tons.

Deliveries of tin to U.K. consumers during September amounted to 2766 tons and deliveries for export were 270 tons. Consumers' consumption of metal during the month was 2573 tons.

Concentrates of zinc, copper, and lead are being produced on an increasing scale by the Buchans mine in Newfoundland, according to American industrial press reports. With a daily output of 1200 tons, the mine is exceeding its 1945 production by 200 tons a day. Total production of concentrates for 1945 is recorded as: zinc, 93,567 tons; lead, 39,567 tons; copper, 17,570 tons.

Chemical Exports

Further Drop in Figures for September

THE value of U.K. exports for September was £70.8 million, a reduction of £6.5 million on the August figure, which was itself £14.5 less than the record July figure. About half the September reduction, states the Board of Trade, was due to the smaller number of working days (25 as against 26 in August). The reduction for both the past two months was essentially due to the general holiday season, which continued well into September, and present indications are that exports in October will approximately equal the peak figure of £92 million recorded for July.

The general decline in the September exports was reflected in the exports of chemicals, drugs, dyes and colours, which, according to the Board of Trade monthly accounts, were valued at £4,575,468. This is £1,251,980 less than the August figure, but £2,529,498 more than for September last year; and £3,968,799 more than the monthly average for 1938. Chemical manufactures and products (other than drugs and dyestuffs) accounted for £2,670,536 of the total; drugs, medicines and medicinal preparations for £839,100; and dyes and dyestuffs, and extracts for dyeing and tanning, for £506,583. British India again led the buyers with purchases totalling £696,005; Australia was again second with £360,271; and Denmark came into third place with £251,320. For the nine months ended September 30 the total was £48,527,138, which is £21,883,958 higher than the figure for the first nine months of last year.

The value of imports generally for September was £106.1 million, a reduction of £14.9 million compared with August. About a quarter of the reduction was due to the shorter month. Imports of chemicals, drugs, dyes and colours were valued at £981,673, which is £545,179 less than the August total; £50,640 less than for September last year; and £153,728 less than the monthly average for 1938. The U.S.A. was the largest supplier, with goods valued at £177,355; the Argentine Republic was second (£124,570); and Canada third (£81,339).

Leather Chemists

Paper on "Currying and Fatliquoring"

AT a meeting of the Northampton Group of the British Section of the International Society of Leather Trades' Chemists, at the Northampton College of Technology, on October 24, with Mr. D. Woodroffe, M.Sc., A.R.I.C., in the chair, Dr. M. P. Balfe, B.A., F.R.I.C., gave a paper entitled: "Currying and Fatliquoring."

He dealt first with the chemical changes which may occur to the grease in the leather. Triglycerides are split by the action of moulds forming free fatty acids, and unsaturated oils, such as cod oil, may form gummy spues on oxidation. Factors which can affect these two types of changes were discussed. The most important feature of currying was the effect on fibre structure. For high tensile strength and good flexibility, a low angle of fibre weave and a good degree of splitting of the fibres into fibrils were required. The angle of weave was not greatly affected by the currying processes, but was governed mainly by the type of skin and the tanning process. The main purpose of currying was to retain in the finished leather the fine splitting which was present in the original leather before drying. This was affected by the pre-tanning and tanning processes. The methods by which oil or grease was put into leather by various currying processes, such as hand stuffing, drum stuffing and fatliquoring, were described.

The ease with which oil can penetrate into the fine inter-fibrillary spaces so as to lubricate the fibrils and preserve the fine splitting was affected by the viscosity of the oil and the oil/water interfacial tension. Representative figures for these properties in a number of oils were given and used in a comparison of the effects produced by different oils. Cod oil was particularly suitable where good penetration was required, on account of its comparatively low viscosity and interfacial tension. Neatsfoot oil penetrated less well because it had higher values for these properties. Mineral oil could give satisfactory results if one with a suitable viscosity was selected and modified to give the appropriate interfacial tension. Other examples were given, and slides were shown to demonstrate the effect on fibre structure.

Birmingham's Giant Nuclear Research Machine

A gigantic machine weighing more than 1000 tons and containing a magnet 30 ft. in diameter, is being installed at Birmingham University. The machine, which will be used for nuclear research, will develop energies amounting to 1,000,000,000 volts. According to Professor M. L. Oliphant, who gave details of the machine, the enormous electrical energies which it will attain may help to solve the problem of the nature of the "glue" which holds the atomic nucleus together. The machine, Professor Oliphant emphasised, is not a large cyclotron.

"Portraits of an Industry"

I.C.I. Exhibition of Pictures

FEW people, whether inside the chemical industry or outside it, can fail to have admired the series of striking I.C.I. advertisements in the lay Press, portraying typical chemical workers and telling, in simple, every-day language, something of their jobs. Apart from the fact that the portraits themselves made an instant appeal and that the text conveyed interesting information not generally known, the general lay-out of the advertisements evoked high praise.

An opportunity to see the original portraits, which were executed by well-known artists in oils, water-colours or other media, is now presented to the general public by the Central Institute of Art and Design, under whose auspices an exhibition of the pictures is being held in the Suffolk Galleries, Suffolk Street, London, W.C.2 (close to the National Gallery), by courtesy of the New English Art Club. The exhibition, which has the title of "Portraits of an Industry," and is described as "An exhibition of pictures depicting the personnel, aspects and services of the British Chemical Industry," is open daily from 10 a.m. to 5 p.m. (except Sundays), until November 9.

The first of its kind to be held in this country, the exhibition embraces 85 pictures by nineteen artists. It demonstrates the possibilities of industry becoming an intelligent patron of the fine arts and, at the same time, contributing towards a higher standard of publicity. The application of art to advertisement by I.C.I. ranks high among the many notable developments in the relation of the arts to the public that have taken place during recent years. Indeed, the policy followed by I.C.I. of thus employing distinguished artists is of no little significance. It indicates that advertisement, so prosecuted, can not only provide artists with a remunerative source of employment, but afford the public a new and beneficial contact with the arts.

The origin of this movement is to be found in the fight which, at the outbreak of war, British scientists had to make against the tremendous world prestige enjoyed by Germany. That prestige was the outcome of years of forceful propaganda in a field where Great Britain had done virtually nothing in that direction. As the war progressed, the falling off of Great Britain's international trade progressively weakened the contacts between her and the world beyond this island, and in this way British goodwill was still further jeopardised. As the export of goods declined, so it became all the more

Samuel Wilson is engaged in dyestuff manufacture at the I.C.I. factory at Huddersfield.

Alice Wright filters and inspects liquid synthetic resin.

John Williams is manager of a heavy chemical works at Runcorn.

necessary for ideas to be projected in their place.

These were the considerations which, in 1941, impelled the I.C.I. public relations controller, Mr. Sidney Rogerson, to seek his directors' permission to launch a public relations programme designed to raise throughout the world the prestige of British research and the British chemical industry. The permission was forthcoming. To achieve his objectives, Mr. Rogerson came to the conclusion that he should break away from the conventional form of advertising; that he should be original, not only in manner, but in idea; and that all attempts at "ex parte" pleading should be shunned.

The form of advertising developed as a result of this was designed to tell the public something that was interesting and yet not commonly known. It also had regard to Mr. Rogerson's further contention that advertising, instead of being an unlovely source of revenue to newspapers, could and should be an adornment to the pages in which it appeared. It was not enough, he felt, nor even sound, to take space in which to place a blatant, staring advertisement on the assumption that the reader could be bludgeoned into accepting the message.

As Sir Charles Tennyson states in a foreword to the exhibition catalogue: "It is not too much to say that these I.C.I advertisements have made advertising history. They have carried a message overseas not only on behalf of the British chemical industry but of British art. Their influence has been deep and will, I am sure, be lasting."

Henry Bowmer works at the plastics factory, Welwyn Garden City.

Sir Charles goes on to say: "As chairman of the Central Institute of Art and Design, I cordially welcome this policy of a great industrial organisation. It is educating the public. It is showing both the Press and other advertisers that work of dignity, beauty and character can be more effective than the blatant and flashy. It offers leading artists a worthy outlet for their talents."

Chemicals in Holland

Development of a Plastics Industry

AMONG the many chemical projects in Holland which are aiming at the home production of vital articles formerly imported from Germany, the plans for manufacturing plastics seem likely to materialise soon. For some six months the matter has been under serious consideration between the Government authorities at The Hague and the industries concerned; but the problem of supplying the primary chemical products, except for casein and phenol, has so far proved insoluble. Holland is in need of plastic materials for making export products, such as lacquers, but its cellulose industry is still too small. Two moves are being made, however. Under the title of International Synthetic Materials Industry, Ltd. (N.V. Internationale Kunststoffen Industrie), the Internationale Kunsthoorn Industrie of Voorschoten is to start a company for the production of thermoplastic and thermosetting articles; while the rubber-tyre producer, Vredestein Ltd., of Loosduinen, known to be in close relation with the American firm of Goodrich, is putting up another plastics factory at Deventer, under the name of N.V. Kunstoffenfabriek Plastico.

Nitrogen Products

The output of nitrogen by the State Mines concern at the Lutterade factory in the current year is estimated at 54,000 metric tons; and steps are being taken to produce also calcium nitrate, ammonium nitrate, and phosphate. Meanwhile, Dutch output of superphosphate is said to be very near the normal and bids fair to compete in the foreign market, as there is sufficient supply of imported pyrites and raw phosphates. As a matter of fact, superphosphate and sulphuric acid represent the most valuable items among all the chemical products of Holland, being valued at some 28 million florins.

The Royal Dutch oil refinery at Pernis, which during the war endured heavy allied air attacks, not to mention the wholesale looting of its machinery by the Germans, is now wholly restored, according to a statement made by the subsidiary company, Bataafsche Petroleum Maatschappij, which hints at impending new installations. For the time being the throughput (in metric tons) for crude oil amounts to 45,000 a month, cracking 60,000, polymerisation 3000, the same for hydrogenation and special petrol distillation, asphalt distillation over 20,000, gas processing 10,000, redistillation 30,000, lubricants 2000, and refining 15,000 tons. At the same time crude petroleum—so far of inferior quality—is being produced by the Bataafsche company in the province of Drenthe, near the German frontier. The well is believed to extend beyond the frontier and the Dutch are claiming it along with other frontier adjustments. At Schoonebeek 23 derricks have been erected, and the present crude output is at the rate of 300,000 metric tons per annum, with methane and carbon black as special derivatives.

Output of salt in Holland, for which the Royal Dutch Salt Industry, Ltd., of Boekelo and Hengelo, has the monopoly, at the moment amounts to at least 170,000 tons per annum, compared with 54,000 tons in 1945 and the record output of 209,000 tons in 1940. Because of urgent demands for edible salt as well as for chemical products, an ambitious plan aims at increasing the yearly output to 800,000 tons. The company is well equipped with machinery and capital and is producing also chlorine, sodium lye, hydrochloric acid, caustic soda, etc. The fact that the German salt industry is no longer able to compete on the Dutch market is stimulating these plans.

Among insecticides, DDT is already being produced in Holland, while Gammexane is to be manufactured in due course. A new anti-itch preparation called Debraline, the composition of which has not yet been revealed, has been released for the home and export market.

Anglo-Dutch Discussion

Business Men Meet

REPRESENTATIVES of Dutch and British industries met recently in London at the invitation of the Federation of British Industries, to discuss matters of common interest. Sir Clive Baillieu, President of the F.B.I., presided at the first session, while the Dutch delegation was led by Mr. H. P. Gelderman, President of the Netherlands Federation of Industries. Discussions between the delegations ranged over a wide field, from government control over business life to the proposals of the Allied Control Commission on the level of German industry.

On the question of International Boards which have been created, or are to be created, to distribute raw materials, the Dutch delegates thought that smaller countries should have more direct and effective consultation with the Boards. The American proposals for an international conference on trade and employment were welcomed by both delegations. On the matter of the post-war level of German industry, the Dutch delegates pointed out the close connection between Dutch prosperity and restoration of German industry, and referred to their pressing need for German goods, especially machine spare parts. At the end of the conference the two sides decided to exchange views periodically.

A CHEMIST'S BOOKSHELF

THE CHEMISTRY OF THE ACETYLENIC COMPOUNDS; Volume 1—The Acetylenic Alcohols. By A. W. Johnson, Ph.D. London: Edward Arnold. Pp. 370. Price 35s.

Reference even to modern textbooks of Organic Chemistry will show that compared with other hydrocarbons very little space is devoted to acetylene or the alkynes in general and the same is unfortunately true of any other compounds which contain the characteristic acetylenic triple bond. This means that the average organic chemist, during his training, is not made aware of the many compounds containing a triple bond, which, far from being academic curiosities, are of great commercial importance. The situation with regard to acetylene itself and related hydrocarbons has been reviewed up to 1938 in several textbooks published in America during the period 1934-45.

The present volume is the first of a series of three which aims at filling the gap with regard to other functional derivatives of acetylenic compounds and deals with the acetylenic alcohols. Volume II and III will review the acids and the carbonyl compounds respectively. Volume I is divided into three parts, the first of which deals with the monohydric acetylenic alcohols, part 2 with the acetylenic glycols, including polyhydroxy acetylenic compounds, and part 3 with the polyacetylenic compounds. The same method of presentation is followed in all three parts and this has the advantage of facilitating reference to any particular branch of the subject. The general layout of each section is that there is an historical introduction giving details of the discovery of the first member of the series under review. After a note regarding the nomenclature of the compounds all the known methods of formation are listed and these are divided up into general methods of preparation and miscellaneous special methods. In a great many cases the remarks under the methods of preparation are directed mainly at pointing out the type of compounds to which the method is applicable. For actual details of the preparation the reader is referred to the original literature for which copious references are given, and these are collected together at the end of each section.

The properties of the compounds are divided into physical and chemical. Under the former heading are listed such things as dielectric constants, Raman and absorption spectra and for several such properties there is no discussion but merely a list of original references. Since all the types of molecules under review contain at least two functional groups, i.e., the triple bond and the hydroxyl group, consideration of their chemical properties is divided into two sections—those in which the hydroxyl group is concerned and those involving the acetylenic bond.

Owing to wartime conditions there has been a delay between completion of the text and publication of the book. In order to overcome this drawback the author has added an appendix, in which he has reviewed all the papers and patents which have been published during the hiatus. By this means all the literature is reviewed up to September, 1945. There are also separate appendices dealing with the chemistry of the rubenes and applications of acetylenic compounds to syntheses in the sex hormone series.

In this volume the author has endeavoured to review the extensive literature of the acetylenic alcohols and in all cases many references are quoted. In addition he has summarised in tabular form at the end of the book the physical constants of all the known acetylenic alcohols listed according to the system of Richter's Lexikon. Much trouble has been taken in compiling the wealth of data in the present volume and it will prove of great value to research workers who wish to use these reactive acetylenic compounds as starting materials in organic syntheses, a branch of chemistry which is as yet little developed. It is to be hoped that the other two volumes will not be long delayed.

Alumina Preparation

U.S. Research

A REPORT of the Bureau of Mines, United States Department of the Interior, deals with pilot plant investigations concerning preparation of alumina from potassium alum. Four different procedures for dehydration of alum were investigated, spray drying, rotary-kiln drying, dry grinding in a thermal ball mill, and dehydration in the vertical-column flash dehydrator. Based upon fuel requirements and other practical considerations, the vertical-column dehydrator, or some other modification of its operating principle, offers the best possibility for commercial use.

Thermal decomposition of dehydrated alum was investigated in both a hearth furnace and a direct-fired rotary kiln. The rotary kiln appeared to have several marked advantages, chief among which is the lessened possibility of contamination of the finished product.

In the report of the annual dinner of the A.B.C.M. in our issue of October 19, Mr. Ian Orr, chairman of the British Barytes Producers' Association, was, by mistake, referred to as Sir Ian Orr.

German Technical Reports

Latest Publications

SOME of the latest technical reports from the Intelligence Committees in Germany are detailed below. Copies are obtainable from H.M. Stationery Office at the prices stated.

BIOS 479. Some aspects of the German peat industry (2s.).

BIOS 609. Non-destructive testing of materials (2s.).

BIOS 662. *I.G. Farben, Ludwigshafen*: Manufacture of phenylbetanaphthylamine, antioxidant for rubber (6d.).

BIOS 663. *I.G. Farben., Ludwigshafen*: Manufacture of synthetic resins (6d.).

BIOS 665. *C. F. Boehringer and Sohn, Sandhoferstr., Mannheim-Waldhof*: Manufacture of vanillin, coumarin, anisaldehyde (6d.).

BIOS 666. *I.G. Farben, Uerdingen*: Manufacture of phthalic anhydride, benzoic acid, etc. (1s.).

BIOS 667. *I.G. Farben., Mainkur*: Miscellaneous chemicals (insecticides, textile agents, oils) (1s.).

BIOS 678. *I.G. Farben, Wolfen*: Manufacture of cement and sulphuric acid from anhydrite (3s. 6d.).

BIOS 709. *I.G. Farben., Hoechst-am-Main*: The production of tetranitromethane and nitroform—alternative compound to nitric acid for use as an oxygen donator in the V. weapons (1s. 6d.).

BIOS 710. *Kalle and Co. (I.G. Farben A.G.), Wiesbaden, Biebrich*: Manfacture of biolase (starch-hydrolysing enzyme) (1s.).

BIOS 716. German steel foundries (includes information on silicosis preventive measures) (6s. 6d.).

BIOS 719. *Interview with Professor Otto Bayer, formerly director and head of the scientific laboratories of I.G. Farben., Leverkusen*: Chemistry of isocyanates and the new polyisocyanates (1s.).

BIOS 740. *G. F. Boehringer und Soehne, Mannheim-Waldhof*: Commercial organic solvent production (1s.).

BIOS 741. *Zellstofffabrik A.G., Mannheim*: Recovery and dehydration of alcohol from spruce-wood waste sulphite liquor (1s.).

BIOS 743. *I.G. Ludwigshafen*: Manufacture of cyclohexanol, cyclohexanone, cycloketone resins (1s. 6d.).

BIOS 748. *I.G. Ludwigshafen-Oppau*: Manufacture of fatty acids by oxidation of paraffins, hydrogenation of the fatty acids (2s.).

BIOS 749. *I.G. Hoechst*: Manufacture of diketene from acetic acid (6d.).

BIOS 750. *I.G. Ludwigshafen*: Manufacture of monomeric styrene.

BIOS 753. *I.G. Ludwigshafen*: Manufacture of phthalic anhydride and phthalates (2s.).

BIOS 754. *I.G. Oppau and Ludwigshafen*: Hydrochloric acid (1s.).

BIOS 757. *I.G. Ludwigshafen*: Manufacture of ethylene cyanhydrin (6d.).

BIOS 759. *I.G. Oppau*: Pilot plant for manufacture of acrylonitrile (6d.).

FIAT 66. Glossary of some German names for chemical products used in the paint, varnish and lacquer industry (1s. 6d.).

FIAT 92. German processing of fats, oils and oilseeds (10s. 6d.).

FIAT 292. Manufacture of laboratory apparatus, instruments and equipment (1s. 6d.).

FIAT 556. Some aspects of rayon and synthetic fabric dyeing and processing (5s.).

FIAT 686. Casting methods for aluminium and aluminium alloy billets (1s. 6d.).

FIAT 713. *Schering A.G., Berlin*: Cellulose acetate manufacture (1s. 6d.).

FIAT 499. Production of wood sugar and its conversion to yeast and alcohol (11s.).

Butane in Scotland

Distribution on Larger Scale

SCOTTISH Rural Gas, Ltd., is developing the distribution of butane throughout Scotland on an increasing scale, consequent on improved conditions and the Government approval of the re-establishment of country workers in better homes.

Authority has been given for the erection at Perth of a large storage building for the butane cylinders, while transport has now been organised to bring the cylinders from England direct to the depot at Perth and elsewhere. There is also a strong possibility that a manufacturing source will be established in Scotland in the early part of 1947 to manufacture the gas, thus facilitating the development of a Scottish butane industry. No precise details are available of this development as yet. The company has opened offices at Aberdeen, Inverness, and in Edinburgh and Glasgow, while the Western Highlands are due for early development.

A main problem at present is the shortage of equipment, since the gas service is limited to the extent to which equipment is available. A recent important development is the design of a two-way automatic cylinwhich transfers flow from a depleted cylinder to the remaining full cylinder without depressing the flame. This new control is being manufactured in Scotland and is exclusive to the company. As a matter of policy, only ex-Service men are being employed in this development programme.

Parliamentary Topics

Fluorine Hazard

IN the House of Commons, last week, Mr. Herbert Morrison, replying to a question by Mr. Charles Williams, stated that investigation of the fluorine hazard near Fort William had involved extensive collection of information and analysis of materials. The work had only just been completed and he was not yet in a position to say when a report would be published. He would give consideration to the suggestion that the report should be made public.

Soap Substitutes

Mr. Collins asked the Minister of Food whether he would make a statement with regard to the progress made in the manufacture of soap substitutes.

Mr. Strachey replied that additional plant to produce raw material for the manufacture of soap substitutes was going up, but until it comes into operation about next March, shortage of suitable raw material would remain a limiting factor.

Ground Nuts

Sir P. Macdonald asked the Secretary of State for the Colonies whether he would arrange for the early publication of the report of the Commission of Inquiry which went to East Africa to investigate the possibilities of large-scale production of ground nuts in Tanganyika and Northern Rhodesia.

Mr. Creech Jones said the Government was actively considering the action to be taken on the report of the mission and he hoped a statement would be made at an early date. The Government would bear in mind the desirability of publishing the material made available.

Production of Penicillin

The Ministry of Supply, replying to a question by Wing-Commander Robinson, said the present rate of production of penicillin in Great Britain was about 260,000 mega-units a month. During September, export licences were issued for about 149,000 mega-units.

Russia and German Industry

Scientists Deported

RESEARCH scientists and specialist engineers are among the German technicians and skilled workers whose recent removal to Russia from the Russian zone of Germany and the Russian sector of Berlin has provoked international interest and controversy. Reports of the dismantling or projected dismantling by the Russians of German manufacturing plant and its transfer to Russia as reparations has also aroused speculation and concern.

Of 300 technical specialists and skilled workers removed with their families last week from Jena in Thuringia, 280 were employed at the famous glassworks of Carl Zeiss and 20 at the Schott glassworks and associated factories. Dismantling may not yet have started at these undertakings, but it is understood that a Russian commission has been supervising an inventory of all plant.

Among other undertakings from which personnel are reported to have been removed are the firm of Hentschel at Stassfurt in Saxony, where aircraft was manufactured during the war; the Koetschen textile factory at Apolda, and heavy industrial undertakings in the Chemitz area; the Leuna Plastics Works at Merseburg; the Siebel aircraft plant at Halle; the Bleichart machinery works at Leipzig; and the Rabe Institute at Bleicherode in Saxony, where V2 parts were made.

Dismantling of the latter works and of another similar undertaking at Lehesten in Thuringia is reported to have begun, while other plants said to be scheduled for dismantling are those of the various branches of the Zeiss undertaking. The Zeiss-Ikon works at Dresden are stated already to have been dismantled and transferred to Russia.

Protests have been made by representatives of the Schott works, at which 2750 people are employed in the manufacture of raw optical, technical, and chemical glass, and of the Carl Zeiss firm, formerly the world's greatest optical works, who employ 14,000. If these two great firms, upon which the town of Jena depends, should close, thousands of glass blowers who work at home in the Thuringian forest making chemical glassware and glass ornaments will be deprived of raw material. Furthermore, since the two firms formerly exported a quarter of their total output, the effects would be more than local, and industry and research in other countries would be deprived of essential equipment.

According to *The Times'* correspondent few, if any, of the personnel who have gone to Russia went voluntarily.

Representations made to Russia by the other occupying authorities in Germany have drawn a reply from the Russians, who defend their actions on two counts: firstly, that all the German workers went voluntarily and under contract freely accepted; secondly, that the British, American, and French have themselves carried out similar deportations on an even bigger scale.

UNRRA supplied, from the beginning of its operations until the end of July, 1946, a total of 1,471,020 tons of oil products to various European countries.

Personal Notes

MR. N. NEW, B.Sc., has been appointed Assistant in Chemistry at University College, St. Andrews.

MR. W. RHYS-DAVIES, F.R.I.C., inventor of waterproofing, dyeing and finishing processes, and formerly consulting analytical chemist in the West Riding of Yorkshire, has been elected to Fellowship of the Textile Institute.

SIR JOHN ANDERSON, PROFESSOR ERNEST LAWRENCE, professor of physics at the University of California; and PROFESSOR NIELS BOHR, director of Theoretical Physics at the University of Copenhagen, received honorary degrees of Doctor of Science at McGill University.

DR. ADAM S. T. THOMSON, who played an important part in research and the design and development of new rocket weapons during the war, is to succeed Professor W. Keir as Professor of Civil and Mechanical Engineering and Applied Mechanics at the Royal Technical College, Glasgow, where he was formerly a student, and is now senior lecturer in the department mentioned.

Obituary

MR. WILLIE WOOD, a local director of Thos W. Ward, Ltd., Sheffield, died suddenly on October 21, aged 62. Brother of Mr. George Wood, joint managing director of the firm, he joined the staff in 1897 and had been in control of non-ferrous metals departments since 1922.

MR. G. HART, who had been connected with the Skinningrove Iron Co., Ltd., for 30 years, and of recent years was steel plant manager, has died aged 62. At the funeral the company was represented by the chairman and managing director, Mr. R. Mather; the general works manager, Mr. H. D. W. Debenham; and, among others, the chief chemist, Mr. E. G. Brown.

Royal Institute of Chemistry

New Fellows and Associates

THE Council of the Royal Institute of Chemistry of Great Britain and Ireland announce that the following have passed the examinations for fellowship: Kenneth Saddington, B.Sc. (Lond.) (inorganic chemistry); E. F. Norris, B.Sc. (Lond.), A.M.I.Chem.E. (organic chemistry); R. J. Salmon, M.Sc. (Manc.) (biochemistry) L. C. Dutton (biochemistry, with special reference to nutrition and vitamins); A. J. M. Bailey Malcolm, B.Sc. (Lond.); Raymond Ganday, B.Sc. (Lond.); J. McLaren Malcolm, and Joseph Markland, B.Sc. (Lond.) (the chemistry, including microscopy, of food and drugs, and of water); F. S. Archer (industrial chemistry with special reference to petroleum); D. G. Wallwork (industrial chemistry with special reference to the manufacture of pulp and paper); W. K. Matthews (general analytical chemistry).

The following passed the examination in general chemistry for the associateship of the Royal Institute of Chemistry: P. L. Barrett, Central Technical College, Birmingham; T. J. Bowditch, Technical College, Cardiff; J. S. Broadley, The University and The Royal Technical College, Glasgow; W. D. Carswell, B.Sc. (St. Andrews), The University of St. Andrews; A. V. Clark, South-West Essex Technical College, Walthamstow; W. E. Clark, Central Technical College, Birmingham; C. D. Cook, City Technical College, Liverpool; C. L. Denton, Central Technical College, Birmingham; C. V. Green, The University, Liverpool; J. Ruff Gwilt, Acton Technical College, London; Francis Hardesty, Rutherford College of Technology, Newcastle-upon-Tyne; Clive Jackson, Harris Institute, Preston; H. T. Jobsan, Rutherford College of Technology, Newcastle-upon-Tyne; C. R. Lloyd Jones, B.A. (Cantab.), The University, Cambridge; K. G. Latham, B.Sc. (Lond.), South-West Essex Technical College, Walthamstow; I. A. McChristie, Royal Technical College, Glasgow; G. W. Nendick, Municipal Technical College, Hull; K. R. Payne, University College and College of Technology, Leicester; Donald Pickles, B.Sc. (Lond.), Municipal Technical College, Halifax; Bernard Priest, Technical College, Coventry; S. G. Reeve, Woolwich Polytechnic, London; D. A. Reilly, B.Sc. (Manc.), The University, Manchester; A. D. Richmond, Technical College, Blackburn; Edward Rogers, Technical College, Huddersfield; J. R. H. Schenkel, Central Technical College, Birmingham; F. T. Smith, Woolwich Polytechnic, London; W. D. Smith, College of Technology, Manchester; G. F. Snook, B.Sc. (Lond.), University College, Southampton; R. K. Taylor, City Technical College, Liverpool; Miss Mary Warner, B.Sc. (Lond.), Municipal Technical College, Hull; J. A. White, Birkbeck College, London; L. H. Williams, College of Technology, Manchester; J. B. S. Wilson, South-West Essex Technical College, Walthamstow.

A new factory is to be built by MacLachlan Clark & Co., Ltd., manufacturing chemists, Glasgow, in the Hillington Industrial Estate, Glasgow, for the manufacture of a wide range of specialities. Modern in every way, the factory will cover about 20,000 sq. ft. and will be ready for use in about six months. It will be used essentially to develop export business.

General News—From Week to Week

Copies of D.T.D. Specification 693, "Aluminium Alloy Tubes," are obtainable from H. M. Stationery Office, price 1s.

Registered and unregistered letters, also printed and commercial papers, may be sent by surface route to all countries in Europe, except Germany.

The "Britain Can Make It" exhibition at the Victoria and Albert Museum, London, is to remain open until December 31. It will then be dismantled.

The address of the Hygienic Chemical Co., Ltd., has been changed to 600 Commercial Road, London, E.14 (Tel., Stepney Green 3434; telegrams, Hygicide, Pop. London).

According to the Chemical Worker, the membership of the Association of Chemical Employers comprises 267 firms, as follows: heavy chemicals, 141; fertilisers, 33; glue-gelatine, 21; plastics, 12; drugs and fine chemicals, 60.

New colours for women's wear for the spring and summer season next year have been grouped together by the Dyers' and Finishers' Association and the British Colour Council under the heading "Summer Landscape."

With the title *You Amaze Me, Young Man*, an attractive and unusual booklet on thermal insulation has been prepared specially for managements by the Ministry of Fuel. Copies are obtainable from regional offices of the Ministry.

Mr. Shinwell, Minister of Fuel and Power, told a Dudley, Worcestershire, audience that the Government would spend £15,000,000 in the next five years to get the mining industry on its feet. Electricity would be dealt with next, and the gas industry afterwards. He would then be able to co-ordinate all forms of fuel and power in this country.

Benn Brothers, Ltd., proprietors of THE CHEMICAL AGE, will be exhibiting their trade and technical journals and other publications on Stand D.D. at the technical exhibition which will be held in the Kelvin Hall, Glasgow, from November 15-27 (10 a.m.-8 p.m.). Readers are cordially invited to visit the stand and make full use of the services available there.

At a joint meeting of the Industrial Accident Prevention Groups of Glasgow and Lanarkshire at Glasgow, last week, a talk was given by Mr. H. R. Payne, of I.C.I., Ltd. He said there was frequently resistance at first to the ideas put forward by a safety officer, but it was his business to overcome such opposition and to secure the co-operation and personal interest of the firm's higher executives and supervisors.

A series of six "Secrets of Science" films, sponsored by I.C.I., Ltd., is now in production by G.B. Instructional Ltd. Another film, showing the development of the iron and steel industry, is being produced for the Iron and Steel Federation.

It is announced by De La Rue Plastics, Ltd., that Scottish Plastics, Ltd., is transferring all manufacture of plastic mouldings to Walthamstow, Essex, as from this week-end. The Strathendry works of Scottish Plastics, Ltd., are being taken over by De La Rue Stationers, Ltd., to concentrate entirely on the production of fountain pens, pencils, etc.

A British Purchasing Agency has been set up at Minden under the Sundry Materials Branch of the Board of Trade with the purpose of centralising all exports from Germany to the U.K., except timber and scrap metal. This organisation will maintain the closest liaison with the Control Commission. All purchases are on Government account and distribution will be made through the Sundry Materials Branch of the Board of Trade. All inquiries, which should be in writing and should relate to specific goods, should be addressed to Sundry Materials Branch, 10 Old Jewry, London, E.C.2.

It is over two years since the Scottish Engineering Students' Association was formed as an all-embracing organisation in which young engineers of all branches might meet to read and discuss papers and to exchange views and ideas. That the project has been well worth while is evident from the publication of the Association's "Transactions" in the 1945-46 session, which is just to hand in the form of a well-produced, excellently illustrated little booklet. Besides providing a review of the Association's activities, it reproduces interesting papers which, but for this valuable co-ordination of effort, would have had a much more limited audience.

Foreign News

Switzerland is again importing large quantities of aluminium; imports from Canada amounted to 655 tons in July and jumped to 1622 tons in August.

It is reported that the United States Export-Import Bank has given Turkey a credit of \$25,000,000, repayable in five years at 3½ per cent. to enable her to modernise her railways and industries.

A trade treaty between Brazil and Czechoslovakia was signed at Rio de Janeiro on October 17. Czechoslovakia received a credit for £5,000,000 for the purchase of Brazilian products, covering a period of two years.

Limited commercial distribution of streptomycin through hospitals began last month in the U.S.A. The plan is similar to that used initially for penicillin distribution. More than 1,600 general hospitals have been selected as depots.

Carnauba wax exports from Brazil in the first quarter of 1946, compared with the corresponding period in 1945, increased 59 per cent. in quantity (2177 to 3468 metric tons) and 130 per cent. in value (£577,870 to £1,330,600).

Among five new professorships which are likely to be estabished at the Royal Technical College, Stockholm, are new chairs in chemical plant technology and in metallurgy, according to a report in the Swedish technical press.

The Krupps armament factories at Essen are to be completely dissolved and the iron works blown up, according to a British member of the Krupps Works Control. New industries will be established on the site of the iron works.

A new plant for the production of sulphuric acid will be erected at Hamilton, Ontario, by Canadian Industries, Ltd., at an approximate cost of $1,000,000. The plant will be one of the most modern of its kind and will incorporate the latest developments in sulphuric acid manufacture.

Penicillin tooth powder has been tried out on a number of American school-boys. It was found that when penicillin was used daily in the tooth powder the oral bacterial count dropped from an average of 72,000 to 300 in three weeks, but rose again on discontinuance of the tooth powder.

Educational lectures dealing with important and timely metallurgical subjects will be included in the technical programme of the American Society for Metals during the National Metal Congress and Exposition at Atlantic City, New Jersey, from November 18-22.

Moscow radio has announced that a synthetic oil industry is being developed in the Soviet Union. It is estimated that plants under construction will yield yearly hundreds of thousands of tons of fuel by the end of the five-year plan. Some plants are under construction in Estonia.

Following an agreement reached between British, United States and UNRRA representatives on one hand, and the Italian Ministry of Industry, the Comitato Italiano Petroli (C.I.P.) and the Azienda Generale Italiana del Petroli (A.G.I.P.) on the other, the Italian refining industry will shortly resume the treatment of crude oil. Furthermore, the A.G.I.P. shall, according to the agreement, restore to their owners the assets confiscated during the war from British and American oil companies.

Plans for the establishment of a zinc refinery in Quebec are strongly favoured by the Government and will soon be realised by Canadian mining men and representatives of zinc refining interests in the United States. A considerable amount of power will be used, to make electrolytic zinc.

The first oil deposits to be discovered in Denmark are situated in the island of Mors, Limfjord, states the *Petroleum Press Service*. Tests are being made to establish whether the occurrence is sufficiently important to make drilling operations remunerative.

According to a survey recently undertaken by the reconstruction department of the Kiangsi Provincial Government, tungsten deposits in the province amount to about 1,800,000 tons, while iron-ore and lead occurrences have been estimated at 1,500,000 and 200,000 tons respectively.

A plant for large-scale production of monosodium glutamate from proteins derived from maize-cob processing is being constructed at Decatur, Illinois. When it comes into operation in 18 months it will have a yearly output of more than 1,000,000 lb. of monosodium glutamate and other amino acid products.

France's pig-iron industry worked to 65 per cent. of capacity in August, in which month output amounted to 328,000 tons, compared with 303,000 tons in July and 269,000 tons in June. The corresponding figures for steel read (in tons) 386,000, 378,000 and 345,000, respectively. Output of basic metals decreased slightly from the July level.

Stated to be the most modern of its kind in the world, a large iron and steel works at Volta Redonda, between Rio de Janiero and Sao Paulo, Brazil, was inaugurated recently by President Dutra. Construction was begun early in the war, under American technical supervision, and almost half the cost was met by a U.S. loan of £11,000,000. It is hoped that eventually the plant will supply Brazil with all the iron and steel she requires.

Forthcoming Events

November 4. Oil and Colour Chemists' Association (Hull Section) Royal Station Hotel, Hull, 6.30 p.m. Professor T. P. Hilditch: "Mechanism of Oxidation and Reduction of the Unsaturated Groups in Drying Oils."

November 4. Society of Chemical Industry (London Section; joint meeting with the Institute of Fuel). Institution of Electrical Engineers, Savoy Place, London, W.C.2, 6 p.m. Dr. C. C. Hall: "The Operation and Development of the Fischer-Tropsch and Related Processes in Germany."

November 5. Hull Chemical and Engineering Society. The Church Institute, Albion Street, Hull, 7.30 p.m. Dr. A. N. Mosses: "Fireworks in War."

November 5. Institution of Chemical Engineers. Geological Society's Rooms, Burlington House, London, W.1, 5.30 p.m. Mr. W. F. Carey: "The Effect of Using Hot Air in Grinding Systems."

November 6. North-Western Fuel Luncheon Club. Engineers' Club, Albert Square, Manchester, 12.30 p.m. Mr. R. W. Foot: "The British Coal Industry."

November 7. Textile Institute (Blackburn Branch). Chamber of Commerce, Blackburn, 7.15 p.m. Mr. F. R. Barratt: "New Finishes."

November 7. Textile Institute (Belfast Branch). College of Technology, Belfast, 7.30 p.m. Mr. D. D. Flood: "Uses of Starch in Textiles."

November 7. Royal Institution. 21 Albemarle Street, London, W.1, 5.15 p.m. Professor J. R. Partington: "History of Alchemy and Early Chemistry.—II."

November 7. Society of Dyers and Colourists (Midlands section—jointly with S.C.I.). College of Art and Technology, Leicester, 7 p.m. Professor J. B. Speakman: "The Promotion and Prevention of Milling Shortage."

November 7. Chemical Society. Burlington House, Piccadilly, London, W.1, 7.30 p.m. Discussion on "Nitration" arranged by Dr. G. M. Bennett. Contributions to the discussion will be made by Dr. Bennett and Mr. J. C. D. Brand, Professor C. K. Ingold and Mr. D. J. Millen, Professor Gwyn Williams, and Professor E. D. Hughes.

November 7. Mineralogical Society. Geological Society's rooms, Burlington House, Piccadilly, London, W.1. Dr. Kathleen Lonsdale: "Extinction in crystals in X-ray crystallography": Mr. C. E. N. Bromehead: "Flavus or blavus;" Professor M. A. Peacock and Dr. L. G. Berry: "Studies of mineral sulpho-salts: XIII—Polybasite and pearceite;" Dr. W. Campbell Smith and Dr. G. F. Claringbull: "Pyrophanite from the Benallt mine, Rhiw, Carnavonshire;" Dr. A. F. Hallimond and Mr. E. W. Taylor: "An improved polarising microscope: II—The all-purposes stand."

November 7-November 27. British Plastics Federation. Dorland Hall, Lower Regent Street, London, S.W.1, 10 a.m.—7 p.m. daily. Plastics exhibition.

November 8. Oil and Colour Chemists' Association (Manchester Section). Engineers' Club, Albert Square, Manchester, 6.30 p.m. Discussion on testing methods for pigments, media and paints.

November 8. Society of Leather Trades' Chemists. (London and Home Counties Group). Leathersellers' Technical College, 176 Tower Bridge Road, London, S.E.1, 2.15 p.m. Dr. E. C. Snow: "Prospects for Leather."

November 8. Chemical Society. Joint meeting with Sheffield University Chemical Society. Chemistry Lecture Theatre, Sheffield University, 5.30 p.m. Dr. H. W. Thompson: "Some Applications of Infra-Red Measurements."

November 8. Royal Statistical Society (Industrial Applications Section, London Group). E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2, 6.30 p.m. Mr. K. A. Brownlee, Dr. B. P. Dudding, Mr. D. J. Desmond: "Some applications of multiple correlation."

November 11. Institution of the Rubber Industry (Preston section). Victoria and Station Hotel, Preston, 7 p.m. Mr. Fordyce Jones: "Story of Vulcanisation Accelerators."

November 11. Society of Instrument Technology. College of Technology, Manchester, 7.15 p.m. Mr. A. Jacob: "Handling material in bulk by weight."

November 12. Institution of the Rubber Industry (Midland Section). Goodyear Tyre and Rubber Co., Ltd., Wolverhampton, 7.15 p.m. Mr. F. Siddall: "Rubber machinery developments."

November 12. Institution of the Rubber Industry (Scottish Section). Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow, 7 p.m. Mr. G. C. Tullock: "Training within industry."

November 13. Oil and Colour Chemists' Association (London Section). Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, London, W.1, 6.30 p.m. Mr. N. A. Bennett, Mr. R. M. W. W. Wilson, Dr. F. Wormwell: "Anti-corrosive figments."

Company News

Scientific Inks, Ltd. (406,197), 65, Coleman Street, E.C.2, has increased its nominal capital beyond the registered capital of £5000 by the addition of £45,000 in £1 ordinary shares.

The nominal capital of **Carbidall, Ltd.**, manufacturers of tungsten carbide, etc., Sawrey Street, Feniscowles, Blackburn, has been increased beyond the registered capital of £3000 by the addition of £3000 in 10s. ordinary shares.

The report of **Lightalloys, Ltd.**, for the year ended June 30 shows net trading profit of £19,072, as compared with £57,717 for the previous year. The final dividend of 11½ per cent makes a total of 20 per cent for the year (25 per cent).

The nominal capital of **John Prentice (London) Ltd.,** manufacturers of goods connected with the chemistry trade, etc., 4, Staple Inn, W.C.I, has been increased beyond the registered capital of £5000 by the addition of £25,000.

Scottish Agricultural Industries, Ltd. (controlled by I.C.I.) report that for the year ended June 30 last dividends and other revenue amounted to £134,420, as compared with £134,946 for the previous year. The ordinary dividend remains at 6½ per cent.

Net profit of £32,637—as compared with £32,240 for the previous year—is reported by **W. & H. M. Goulding, Ltd.,** for the year ended June 30 last. The final dividend of 3 per cent. makes a total of 6 per cent., which is the same as before.

New Companies Registered

Newtown Paint & Chemical Company, Ltd. (422,144).—Private company. Capital £1,000 in £1 shares. Directors: H. J. Gilmour: Mrs. D. Gilmour. Registered office: 30, St. Marks Road, Mitcham, Surrey.

Controlled Heat-Treatments, Ltd. (422,026). —Private company. Capital £100 in £1 shares. Thermal treatment of metals, etc. Directors: J. H. Folkes; S. J. Smith. Registered office: Dudley Road, Lye, Stourbridge.

B. & D. Products (Thurrock) Ltd. (421,683).—Private company. Capital £1000 in £1 shares. Manufacturers of cellulose wax polishes and chemical products of all kinds, etc. Directors: H. W. J. Dunning: R. J. Grimes, The Old Vicarage, Grays, Essex.

Ever Ready Fertilisers, Ltd. (421,938).—Private company. Capital £100 in £1 shares. Dealers in and manufacturers of artificial manure and fertilisers, etc. Subscribers: F. Lawrence: F. W. Stevens. Registered office: Bowmans Place, Holloway, London, N.7.

Aimer Products, Ltd. (421,867).—Private company. Capital £2000 in £1 shares. Glass blowers, manufacturers of and dealers in glassware and proprietary articles, chemists, etc. Subscribers: E. J. J. Oldham, A. B. Dale. Registered office: 71 Moorgate, London, E.C.2.

Water Treatments Ltd. (422,184).—Private company. Registered October 23. Capital £2500 in £1 shares. Water supply engineers, well sinkers, manufacturing chemists, etc. Subscribers: J. H. Money; C. H. Loveridge. Registered office: Brook House, Brook Green Road, W.6.

Humpherson & Sons (Fertilisers) Ltd. (421,553).—Private company. Capital £2000 in £1 shares. Manufacturers and importers of and dealers in natural and chemical fertilisers, etc. Subscribers: C. A. Tingey; G. L. Hall. Solicitors: Hyman Stone and Co., 87 Fargate, Sheffield, 1.

Gelatine & Produce (Longacre) Ltd. (422,123).—Private company. Capital £3000 in £1 shares. Manufacturers, importers and exporters of and dealers in gelatine, gelatine products, essential oils and allied chemicals, etc. Directors: H. Brummer; L. R. Shaw. Registered office: 2, Broad Street Place, E.C.2.

Cobra (Wood Treatment) Ltd. (421,876).—Private company. Capital £4000 in £1 shares. Impregnators and re-impregnators of wood and timber, dealers in chemicals, acids and wood preservatives, etc. Directors: W. E. Wolff; L. Magnus. Registered office: c/o Herbert Oppenheimer, Nathan and Vandyk, 20 Copthall Avenue, London, E.C.2.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

DUALLOYS, LTD., London, W., dealers in alloys. (M., 2/11/46.) October 4, £52,500 charge, to Heritable Securities and Mortgage Investment Association, Ltd.; charged on land with factory premises, cottage and other buildings thereon at Salmon Lane, Bridgewater. *Nil. October 16, 1945.

Satisfactions

'ELEPHANT CHEMICAL CO., LTD., London, S.E. (M.S., 2/11/46.) Satisfaction October 8, £7500, registered September 17, 1936.

Chemical and Allied Stocks and Shares

ALTHOUGH the broadening investment demand for industrial, bank and insurance shares which followed the general advance in British Funds has been less in evidence, stock markets were firm. Consols 2½ per cent came in for moderate profit-taking and various other gilt-edged stocks lost a small part of their recent big gains. later, however, buying interest strengthened, but was more selective, particularly in the industrial section.

In accordance with the general trend,

shares of chemical and kindred companies showed further gains on balance, although best levels touched were not fully held. Dunlop Rubber after a further advance, eased to 71s. 9d., while Imperial Chemical at 42s. 6d. were slightly below the highest level touched earlier in the week. Yielding fully 3¾ per cent at their current price, Imperial Chemical offer a yield which compares favourably with the return on a large number of other leading industrial shares, and there is general confidence that the 8 per cent dividend basis which has ruled for many years will be maintained. B. Laporte remained at 94s. 4½d. Fisons were good at 56s. 6d., British Drug strengthened to 54s. 4½d., and Greeff Chemicals 5s. ordinary moved up to 12s.

Colliery shares continued to attract considerable attention, partly on the view that forthcoming results are likely to show a less conservative dividend payment than during the war period. Bolsover were 68s. 3d., Staveley 57s. 9d., Shipley 45s. 9d., and Powell Duffryn 25s. 7½d. Iron and steels moved moderately higher with Guest Keen 43s. 3d., Dorman Long 26s. 3d., and Stewarts & Lloyds rose to 52s. 3d. Suggestions that the steel shortage is likely to increase demand for aluminium castings and alloys drew attention to Birmid Industries, which rose 2s. 6d. to 93s. 9d., while James Booth were 74s. 4½d., and British Aluminium gained 1s. at 42s. 6d. Talk of a possible increase in the interim dividend strengthened United Molasses to 53s. 6d., and in other directions, De La Rue were good, further advancing to £13½ in anticipation of the "splitting" of the £1 shares into four of 5s. each. Awaiting the dividend announcement, Lever & Unilever became firmer at 50s., and among paint shares Lewis Berger moved higher on hopes of an increase in the forthcoming dividend. Goodlass Wall improved to 31s. 1½d., and Pinchin Johnson to 46s. 3d.

Associated Cement were good at 65s. 9d., with British Plaster Board 5s. ordinary 33s., and Turner & Newall at 85s. 6d. attracted on hopes of a higher dividend for the past financial year. Murex have been firm at 93s. 9d. on further consideration of the results. Distillers at 133s. 6d. failed to hold best levels, and Triplex Glass 10s. ordinary were hesitant at 34s. waiting the full results and chairman's annual statement. Textile shares continued to attract more attention, but British Celanese, after touching 34s. 9d., came back to 34s.; Courtaulds were 53s. 3d., Bradford Dyers 25s., Bleachers 13s. 6d., and Calico Printers 24s. 9d. In other directions Major & Co.'s 2s. shares changed hands around 5s.

Boots Drug 5s. ordinary at 50s. 6d. have continued to participate in the upward trend among leading industrials. Beechams deferred were 26s. 9d., Sangers 33s. 6d., and Timothy Whites 44s. William Blythe 3s. shares have been more active with dealings ranging up to 15s. on higher dividend estimates based on the increase already made in the interim payment. Blythe Colour 4s. ordinary strengthened to 46s. at which there is a yield of over 4¼ per cent on the basis of last year's 50 per cent dividend. Oils have been inclined to lose ground, Shell, Anglo-Iranian, and other leaders easing a few pence, but C. C. Wakefield rose to 69s.

British Chemical Prices

Market Reports

FIRM price conditions have been reported in pretty well all sections of the London industrial chemical market this week, although there have been no important changes in quotations. There has been no appreciable improvement in the supply position and tightness persists for spot or near delivery dates. Existing contracts are being drawn against steadily and new bookings on home and export account have been on a fair scale. Among the soda products a steady demand has been maintained for caustic soda, hyposulphite of soda, and the soda phosphates. The potash chemicals are strong and available parcels are promptly absorbed. Elsewhere, barium chloride, arsenic, formaldehyde, and sal-ammoniac are in good call, while a ready market awaits offers of acetic acid, tartaric acid, citric acid and oxalic acid. The tar products market shows little alteration, and a steady demand is maintained throughout, with pitch very firm.

MANCHESTER.—There has been a fair flow of new inquiry for both light and heavy chemicals on the Manchester market during the past week and this has resulted in further additions to order-books, business including some on export account. The outstanding feature of trade locally, however, has been the persistent call for actual deliveries of a wide range of materials already bought, including textile bleaching, dyeing, and finishing chemicals, for which specifications are circulating regularly. Pretty well all sections of the market are firm in undertone. Basic slag and one or two other fertilisers are meeting with a steady demand, while it is reported that there is a brisk movement into consumption of most of the tar products, including pitch, crude tar, creosote oil, and carbolic acid.

GLASGOW.—Business in the Scottish heavy chemical market during the past week has shown little change. The normal amount of business has passed for both spot and contract trade. Prices have shown a tendency to rise. Export business remains steady.

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of specifications accepted may be obtained from the Patent Office, Southampton Buildings, London, W.C.2., at 1s. each. Numbers given under "Applications for Patents" are for reference in all correspondence up to acceptance of the complete specification.

Applications for Patents

Purification of organic chemicals.—American Cyanamid Co. 28782.

Purification of sugar solution.—American Cyanamid Co. 28782.

Detergent compositions.—American Cyanamid Co. 28783-6.

Cutting oils.—C. Arnold. (Standard Oil Development Co.) 29167.

Oils.—C. Arnold. (Standard Oil Development Co.) 29168.

Cutting Oils.—J. C. Arnold. (Standard Oil Development Co.) 29166.

Electro-deposition of chromium.—P. Berger. 28482.

Refractory substances.—Birmingham Small Arms Co., Ltd., P. H. Lawrence, E. Bates, and A. Deacon. 29024-5.

Cellulosic films, etc.—British Cellophane, Ltd., W. Berry, and C. R. Oswin. 28713.

Resins dispersions.—British Cellophane, Ltd., W. Berry, and C. R. Oswin. 28713.

Treatment of cast iron.—Chromium Mining & Smelting Corporation, Ltd. 29157.

Amines.—Ciba, Ltd. 28556-7.

Dyestuffs.—Ciba, Ltd. 28558.

Nitrogen compounds.—Ciba, Ltd. 29108.

Removal of sulphur compounds.—L. J. Derham, and F. J. Johnson. 28715.

Tocopherols.—Distillation Products, Inc. 28519.

Butan derivatives.—Distillers Co., Ltd., and T. Henshall. 28967.

Streptomycin solutions.—Distillers Co., Ltd., P. D. Coppock, and J. F. Short. 28667.

Acrolein.—Distillers Co., Ltd., E. P. Goodins, and D. J. Hadley. 28883.

Polymeric materials.—E.I. Du Pont de Nemours & Co. 28624.

Mordanting dyeings.—J. R. Geigy, A.G. 28614.

Trihalogenoethane.—Geigy Co., Ltd., I. E. Balaban, and F. K. Sutcliffe. 29071.

Settling tanks.—C. J. Hartley. 29059.

Alloys.—R. A. A. Jernell. 28709.

Separation of minerals.—Kitson & Co., Ltd., and E. A. Knapp. 28731.

Aldehydes.—Merck & Co., Inc. 28760.

Amino acids.—Merck & Co., Inc. 28761.

Riboflavin.—Merck & Co., Inc. 29057.

Refining of metals.—J. Miles, and J. Miles & Partners (London), Ltd. 28979.

Selenium.—N.V. Philips' Gloeilampenfabrieken. 28911.

Analytical balances.—L. Oertling, Ltd., and E. R. Etherington. 29022.

Fluorescent materials.—Orbit Electrical Co., Ltd., and H. J. Thomas. 29073.

Artificial resins.—Quaker Oats Co. 28664.

Cystein preparations.—Roche Products, Ltd. 28751-2.

Pentaenes.—Roche Products, Ltd. (F. Hoffmann-La Roche & Co., A.G.) 28500.

Metallising asbestos.—Schori Metallising Process, Ltd., A. J. Dyke, and F. A. Rivett. 29154.

Light diffusing surfaces.—E. Simms, and I.C.I., Ltd. 28623.

Resinous anion-exchanger products.—Soc. l'Auxiliare des Chemins de Fer et de l'Industrie. 28970.

Metal degreasing.—Solvents Research, Ltd., and N. Drey. 28862.

Polymeric materials.—W. H. Stephens, and J. G. N. Drewitt. 28677.

Magnetic alloys.—Telegraph Construction & Mainteance Co., Ltd., W. F. Randall, and H. H. Scholefield. 28585.

Polymerised ethylene.—Telegraph Construction & Maintenance Co., Ltd., H. F. Wilson, and B. Allwright. 28983.

Flotation equipment.—A. P. Thurston. (Owens-Corning Fiberglas Corporation.) 28537.

Adsorption apparatus.—Union Oil Co. of California. 28538.

Hydrocarbons.—United States Rubber Co. 28679.

Storage vessels.—Whessoe, Ltd., and A. F. G. Austin. 28790.

Material impregnation.—P. Wilderman. 28511.

Varnishes.—P. Wildeman. 28512.

Adhesives.—P. Wilderman. 28642.

Filters.—U. A. F. Williamson. 28575.

Deposition of metals.—C. C. Wood. 29014.

Colouring process.—A. M. Wooler, and I.C.I., Ltd. 28907.

Rust-removing processes.—H. Wunderlich. 28587.

Complete Specifications Open to Public Inspection

Manufacture of β-naphthaselenazole compounds.—Kodak, Ltd. March 31, 1945. 8400/46.

Process and apparatus for making carbon black.—Phillips Petroleum Co. Nov. 6, 1944. 25415/46.

Cellular glass.—Pittsburgh Corning Corporation. March 31, 1945. 9620/46.

Processes for extracting magnesia from magnesium salts in aqueous solutions.—J. C. Séailles. Dec. 13, 1939. 25525/46.

Manufacture of aluminous cements, with special reference to white aluminous cement. J. C. Séailles. April 25, 1939. 25528/46.

Manufacture of a plastic material to be used as substitute for natural leather and material obtained.—J. Seraphim. May 15, 1940. 25772/46.

Processes for extracting and concentrating sulphur dioxide.—S.A. des Manufactures des Glaces et Produits Chimiques de Saint-Gobain, Chauny, & Cirey. Dec. 27, 1940. 25422/46.

Manufacture of varnish compositions.—Soc. des Usines Chimiques Rhône-Poulenc. April 22, 1941. 25459/46.

Varnish composition.—Soc. des Usines Chimiques Rhône-Poulenc. Aug. 4, 1942. 25825/46.

Treatment of boiler feed water.—Soc. l'Auxiliaire des Chemins de Fer et de l'Industrie, and L .F. Armand. May 7, 1942. 25794/46.

Manufacture and use, for example in steam boilers, of anti-scale and corrosion compositions derived from peat.—Soc. l'Auxiliaire des Chemins de Fer et de l'Industrie, and L. F. Armand. May 23, 1942. 25795/46.

Production of alkylated aromatic hydrocarbons.—Standard Oil Development Co. June 19, 1941. 22876/44.

Separating Materials.—Technische Physik A.G. March 31, 1945. 8950/46.

Process for producing volatile hydrocarbons from hydrocarbonaceous solids.—Universal Oil Products Co. March 18, 1944. 25412/46.

Catalyst and process for synthesising organic compounds.—Universal Oil Products Co. May 31, 1939. 25413/46.

Complete Specifications Accepted

Solidifying normally liquid hydrocarbons.—D. M. Clark. (Safety Fuel, Inc.) Feb. 8, 1944. 580,885.

Process for drying alcohol-wet polyvinyl alcohol.—E.I. Du Pont de Nemours & Co. Sept. 2, 1943. 580,899.

Manufacture of catalyst compositions and their application in the syntheses of vinyl fluorides.—E.I. Du Pont de Nemours & Co. Oct. 29, 1943. 580,910.

Manufacture of vinyl cyanide.—E.I. Du Pont de Nemours & Co., C. R. Harris, and W. C. Sharples. July 13, 1944. 581,035.

Manufacture of fatty acid aryl hydrazide sulphonic acids.—J. R. Geigy, A.G. March 3, 1944. (Addition to 547,569.) 581,076.

Magnetic or electrostatic separators for ores and similar materials.—General Electric Co., Ltd., and A. Bloch. Nov. 5, 1942. 581,004.

Recovery and utilisation of tin.—Hanson-Van Winkle-Munning Co. May 21, 1943. 580,987.

Rotary pumps and rotary fluid-pressure motors.—H. R. Hill, and H. Portlock. June 23, 1944. 580,890.

Electrodeposition of tin.—I.C.I., Ltd. July 13, 1943. 581,034.

Electrodeposition of tin.—I.C.I., Ltd. July 13, 1943. 581,036.

Manufacture of hydrocyanic acid.—I.C.I., Ltd. Aug. 10, 1942. 581,003.

Supported catalyst.—E. P. Newton (Baker & Co., Ltd.) Aug. 11, 1944. 580,897.

Process of separating tar acids from tar.—Reilly Tar & Chemical Corporation. July 19, 1943. 580,926.

Hydrocarbon alkylation products.—Shell Development Co. Feb. 22, 1943. 581,014.

Protection of refractory material and metals in contact with molten aluminium.—F. Singer. (J. M. Lucas.) Nov. 20, 1944. 580,916.

Solvent extraction of hydrocarbons.—Standard Oil Development Co. Aug. 29, 1942. 581,006.

Oil retaining and dirt excluding seals for machinery shafts and bearings.—Super Oil Seals & Gaskets, Ltd., and L. A. Moxon. July 7, 1944. 580,988.

Process of and system for the softening of water.—W. W Triggs. (Dorr Co.) Sept. 8, 1944. 580,991.

Therapeutically active compounds of the amidine type. J. Walker. Jan. 26, 1944. 580,884.

Synthesis of secondary and tertiary ethinyl-carbinols.—C. Weizmann. April 18, 1941. (Divided out of 573,527.) 580,921.

Process for the removal of acetylenic hydrocarbons from mixtures of gases or vapours.—C. Weizmann. Sept. 1, 1943. 580,922.

Method and apparatus for drying drugs and like materials.—Wellcome Foundation, Ltd. (Burroughs Wellcome & Co. (U.S.A.), Inc.) May 15, 1944. 581,040.

Amino acid preparations intended for intravenous supply of nutrients.—K. A. J. Wretlind. March 29, 1943. 581,016.

WORKING NOTICES

THE Owners of Patent No. 530, 801 are desirous of arranging by way of licence or otherwise on reasonable terms for the commercial development in Great Britain of this invention which concerns IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF LEATHER. For particulars address ELKINGTON AND FIFE, 329, High Holborn, London, W.1.

THE Proprietors of British Patent No. 451,894 for "METHOD FOR THE TREATMENT OF CHLORATES FOR THE PURPOSE OF REDUCING THE RISK OF FIRE," desire to enter into negotiations with a Firm or Firms for the sale of the patent, or for the grant of licences thereunder. Further particulars may be obtained from MARKS & CLERK, 57, & 58, Lincoln's Inn Fields, London, W.C.2.

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